ESAOTE
THE IMAGE OF INNOVATION™

E-SCAN XQ
DEDICATED MRI

MR

Service Manual

Service Manual

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Part 1 Introduction

Overview

The installation and service of equipment described herein is to be performed by qualified personnel which is employed or authorized by ESAOTE or one of its affiliates.

Assemblers and other personnel not employed by nor directly affiliated with nor authorized by ESAOTE or one of its affiliates technical services are directed to contact the local office of ESAOTE or its affiliates before attempting installation or service procedures.

NOTICE	Authorized personnel only must carry out any installation, assembly, maintenance, extensions, regulation, modifications, or repairs.

General

This register contains an introduction to the service manual: what the service manual contains and how it can be best used. It will also attempt to present how the service manual and FUN are coupled together and complement one another. Here you will find a general explanation of the concept structure, the various sections comprising the service manual and how they can be used most effectively for trouble-shooting and repair.

Information on the new page format and on-line documentation are covered in the manual FUN, part Prefix, section “Documentation Into”.

The contents of the service manual will support service technicians during on-site trouble-shooting and faulty component isolation. While the instructions are not a substitute for an in-depth knowledge of the system, its components or the underlying physics, they will facilitate, on the one hand, trouble-shooting procedures for the less experienced technician and, on the other, support the more experienced technician in performing essential measurements and tests. The instructions will also explain standard procedures such as measurements of power supplies, etc.

The service manual should not and does not take the place of an error catalogue. In most cases hardware faults are easily and quickly located. Intermittent errors require more time and patience.

It is not within the scope of the service manual to list all possible tests. Its purpose is to support the search for frequently occurring errors, to allow the technician to limit the error search to certain functional groups, and to propose measurements for localizing a faulty component.

⚠**WARNING** **Some of the System signal present in the picture shown in this manual are acquired modifying the default visualization settings!!!**

Any feedback of this manual is strongly encouraged and will be warmly welcomed.

To provide you with the tools you need, we need your help!!!

Suggestions for use

The information for the different system components has been subdivided into:

– Test Strategy

– Test Procedures

– Repair and Adjustment Procedures

Strategy

The flowchart is designed as a general guideline for selecting the appropriate trouble-shooting procedures.

The objective of the accompanying descriptions is not to give detailed step-by-step instructions into the finer art of trouble-shooting, but to offer a means of guiding you, given a particular problem, to the right test procedure, briefly and simply. If more detailed instructions are necessary, then the CSE will be referred to the appropriate procedures in the section “Test Procedures”.

Procedures

Here the CSE will find detailed test instructions. You will also find descriptions for “standard procedures” - for example, connecting the laptop to the Host, reading log files, etc. This section also contains descriptions for interpreting the test results.

Furthermore you will find general information pertaining to parts location, fuse ratings, power supply information, measuring points, descriptions of LEDs and potentiometers in this section.

Repair

Should a FRU need to be replaced, procedures for its replacement and subsequent necessary adjustments are described in this section.

Part 2 Service Policy

Product Line Support Center

The Support Center provides all general activities targeted to customer support (manuals, training, Service Information, etc.)

Specific Service activities and responsibilities include:

- Service Manuals
- Service Information
- Service Training
- Product Part Lists
- Part repairing process
- On-line support (e-mail, phone, fax, etc.)

The support center are currently open from 8:00 a.m. to 5:00 p.m. (local time) between Monday to Friday, excluding Public Holidays and ESAOTE summer closing period (three weeks in August and some days during Xmas time).

All communications with the center must be in English at these addresses:

Esaote S.p.A
Via Siffredi 58
16153 Genoa Italy
Fax +39106547275
E-mail:MRI.Service@Esaote.Com

Sales and Service administration

The entire Service Administration is managed through your Sales Area Manager. Responsibilities include:

- Spare Parts Price List
- Order Processing
- Repair Administration (invoices and shipments)

Orders

Orders shall be issued to the Export Sales Department according to ESAOTE general rules and your Spare Parts Price List.

Part Numbers are required for prompt order process; items not included in Spare Part Price List cannot be ordered to ESAOTE.

All orders are subject to ESAOTE approval and orders below half million of Italian Lire are not accepted.

Delivery terms on spare parts range between 60-90 days.

Repairs

General conditions for repair

- Any Defective item under warranty shall be returned to ESAOTE for repair/substitution
- Parts declared NON REPAIRABLE in the Spare Part Price List are not accepted once warranty expires
- Parts or products cannot be returned for upgrades unless the upgrade has been previously agreed in writing with ESAOTE
- Parts damaged because of traumatic events or improper handling (example: non-authorized modification or improperly performed modification) will be automatically considered out of warranty and can be declared non-repairable by ESAOTE
- Complete products cannot be returned for repair unless requested by ESAOTE or previously agreed in writing

Procedure for returning goods to ESAOTE

NOTICE	The modules shipped without following the correct procedure won't be accepted

Follow this procedure to send back any item for reparation:

- Fill the Trouble Report (one for every broken module)
  - Make a copy of the T/R contained in this manual
  - Fill the T/R number field following this criteria: XX – 001 – 01

    XX = Distributor initials (ask Service Dep.)

    001 = Progressive trouble number

    01 = Current year
  - Leave empty the ESAOTE T/R number field

NOTICE	If you don't have the T/R form, download it from the ESAOTE Service web site

- Send the filled T/R by fax to the attention of MRI Service Dep. or by e-mail to mri.service@esaote.com
- If you want to send the broken module to ESAOTE, fill the RMA form in every field indicating:
  - **ITEM** name of the broken module
  - **P/N** part number of the broken module
  - **Item Ser/N** serial number of the broken module
  - **System Ser/N** serial number of the system
  - **T/R** trouble report serial number
  - **IC** index configuration number (only for E-SCAN)
  - **Warranty** if the module is under warranty or out of warranty
  - **Comments** for example, write if you need an urgent replacement of one of the broken modules

The Medical Device Directive (MDD 93/42) mandatory forces manufacturer, distributor and technician to guarantee the Ser/N tractability of some system components. See the below table. Every Trouble Report must have the Ser/N of the broken and new components.

Tab. 1: The Ser/N of these modules must be written in the Trouble Report

Code	Components
7900000164	ROD ANTENNA
7900000215	POWER SUPPLY AC/DC 48 V
7900000293	POWER SUPPLY 150 W
8500835001	TX COIL
9100711001	CMAG
9100711004	MAGNETIC COMPENSATION PROBE KIT
9101139004	SITE MEASUREMENT KIT
9101140001	GRADIENT TUNING KIT
9101598200	SRFA 900 W
9101721006	MONITOR TFT 18"
9101722001	OPTICAL LASER PRINT CONNECTION
9101723001	OPTICAL TRANSMITTER AND CABLES
9101724001	OPTICAL RECEIVER
9101802000	MAGNET JOKE
9101815200	SGRA
9101819000	COIL1
9101819001	SERVICE COIL1
9101824000	COIL2
9101824001	SERVICE COIL2
9101909001	UPPER GRADIENT COILS
9101909002	LOWER GRADIENT COILS
9101912000	COIL3
9101912001	SERVICE COIL3
9101913000	COIL4
9101913001	SERVICE COIL4
9101984001	PAVILION
9102002001	FILTER PANEL
9102175003	GANTRY COVERS
9102206000	COIL5
9102206001	SERVICE COIL5
9102274001	PC UNIT
9102292001	CASE
9102313001	SERVICE COIL6
9102348000	INSULATING TRANSFORMER
9102370000	ELECTRONIC UNIT
9102371000	SIGNAL BOX
9102371002	SIGNAL BOX CASE
9102372000	TPM MODULE
9102403000	POWER DISTRIBUTION BOX
9102451000	SRIB
9102500000	APM BOX
9102511000	SMM
9102516000	SFM
9102517000	FILPOW
9102518000	FILGRA
9500479000	AINT BOX
9500524010	RIB MODULE
9500649200	SREGNTC
9500733030	SGRID
9500734100	SGRS2
9500735010	SGRP2
9500789000	SGRD

Code	Components
9500822000	LOOPA
9500825100	SGRC2
9500843010	SFM
9500846000	FILGRA
9500956200	AMP-RFA 900 W
9500965000	RFM 2CH 7.7
9500966000	TPM
9500973000	ACM
9500975000	DSPM
9500986000	MOM
9500997000	MTCM
9501003000	APM
9501014000	SPWS
9501015200	ROSM 900 W
9501016000	SMM
9501040000	SOFT-START SGRA
9700018004	MAGNET
9700019004	SYSTEM

NOTICE If you don't have the RMA form, download it from the ESAOTE web site

- Send it by fax or e-mail to ESAOTE and wait for the RMA authorization form. It is a word file that you will receive by e-mail

NOTICE Not all the out of warranty modules will be authorized (refer to the Repairable Item list)

- Print out the received RMA authorization form and place one copy on the shipment crate. Send the goods to the following address:

ESAOTE S.p.A.
Via Montecchi, 5
16153 Genova, ITALY
Att. MRI Service Dep.

NOTICE The shipment without RMA authorization form attached will be rejects. In case parts have not been accepted for repair, a Notice of Rejection detailing the reasons will accompany goods.

- Make two orders and send them to silvia.bottino@esaote.com or by fax (+39 010 6547275):
  - under warranty modules at price zero
  - out of warranty modules insert the price contained into the Repairable Item list (50% off) of the Spare Part list

NOTICE Indicate on the order the RMA number

Warranty after repair

If originally out of warranty, those parts are warranted after repair for a period of ninety days from ESAOTE shipment.

If in warranty, parts will be covered by saleable warranty or by the extended ninety days, whichever is greater. As an example, should the saleable warranty by expiring in 60 days, after repair warranty will be applied.

Part 3 System

Troubleshooting strategy

In this chapter you will find test strategies encompassing the complete system.

System functionality

All modules present in the system are necessary for different processes.

You must know how the system is composed and how it works in order to identify any kind of trouble.

You can identify some different chains:

- Transmitting gradient driving
- Transmitting coil driving
- Receiving driving
- Thermal control
- Images visualization and storing

You can perform different tests for every chain to identify the defective modules.

A detailed description of the different chains and the different tests is given below.

The most useful and powerful test to check the status of the hardware components is the System Check test.

In the following figures the module locations and their logical connections are shown.

Fig. 1: System Module Locations

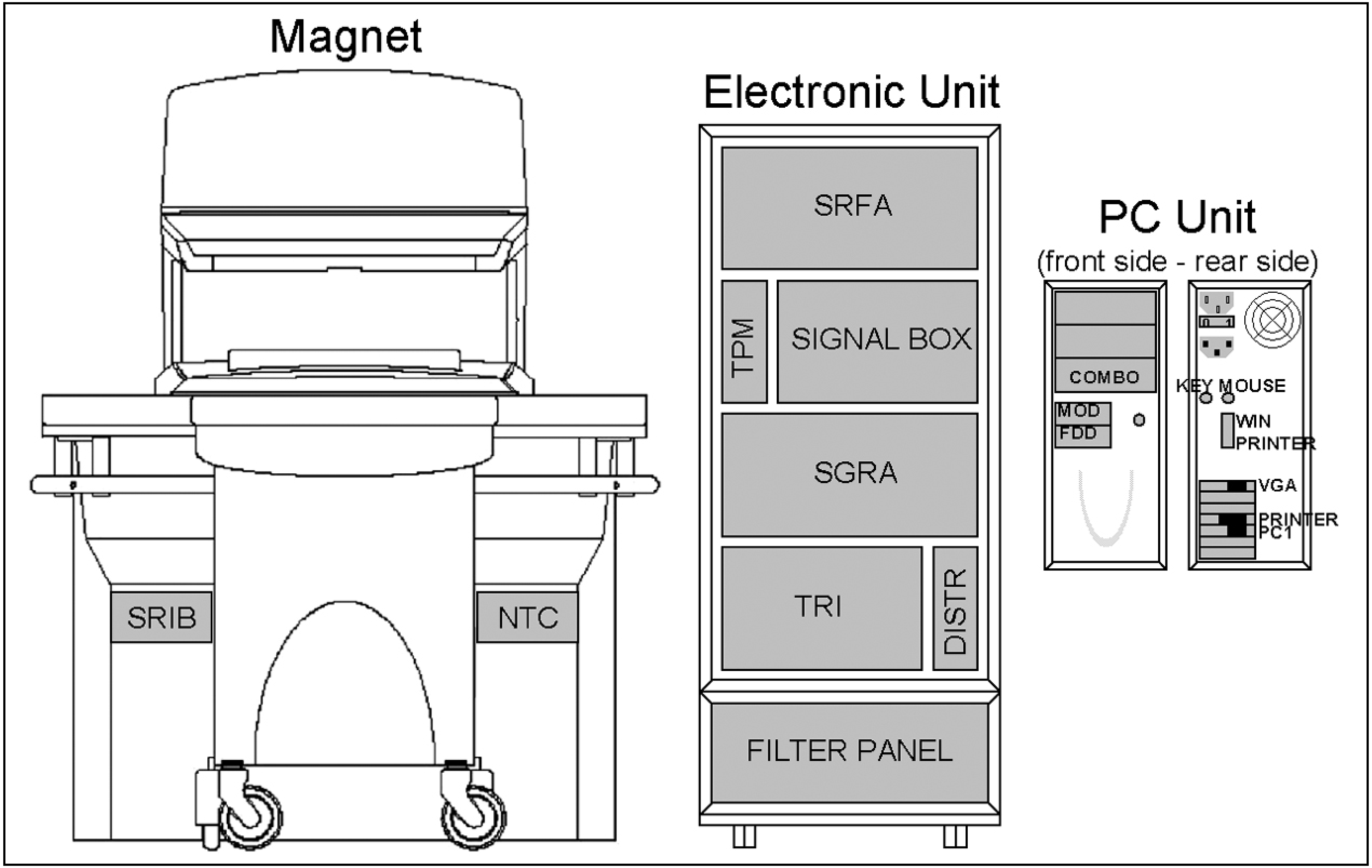


Fig. 2: System Main Scheme

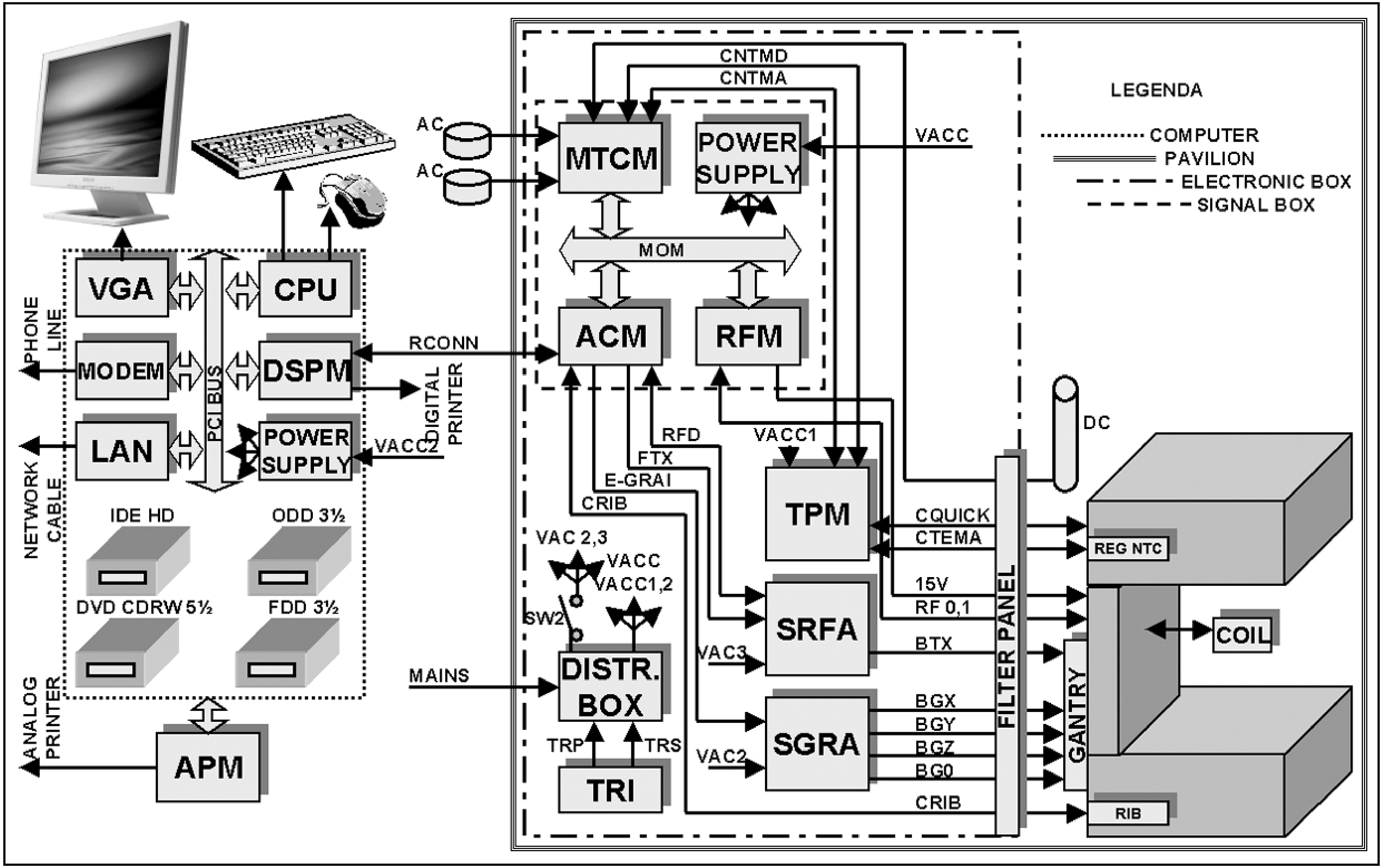


Fig. 3: System Grounding Connection

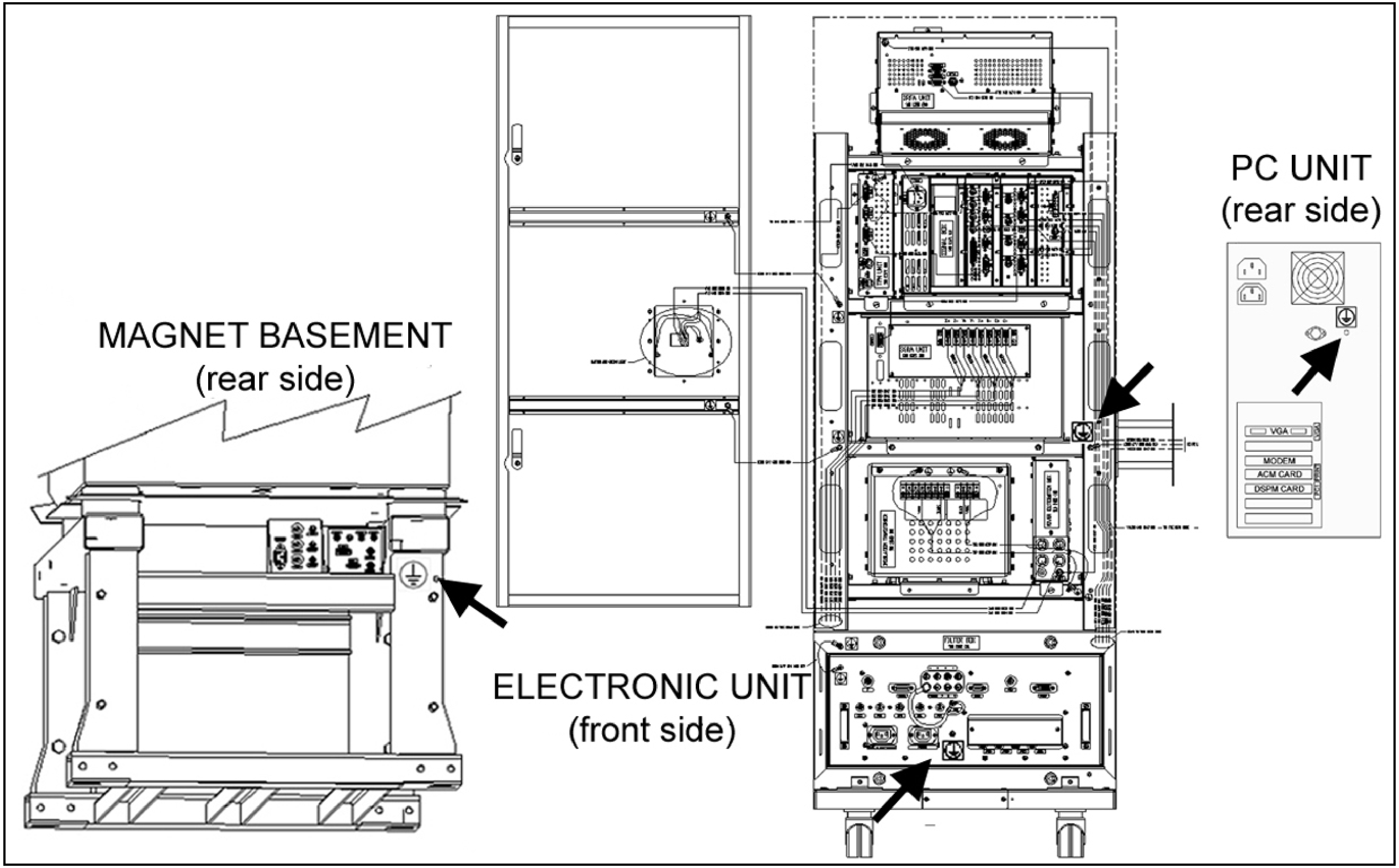


Fig. 4: Electronic Unit Door (rear side)

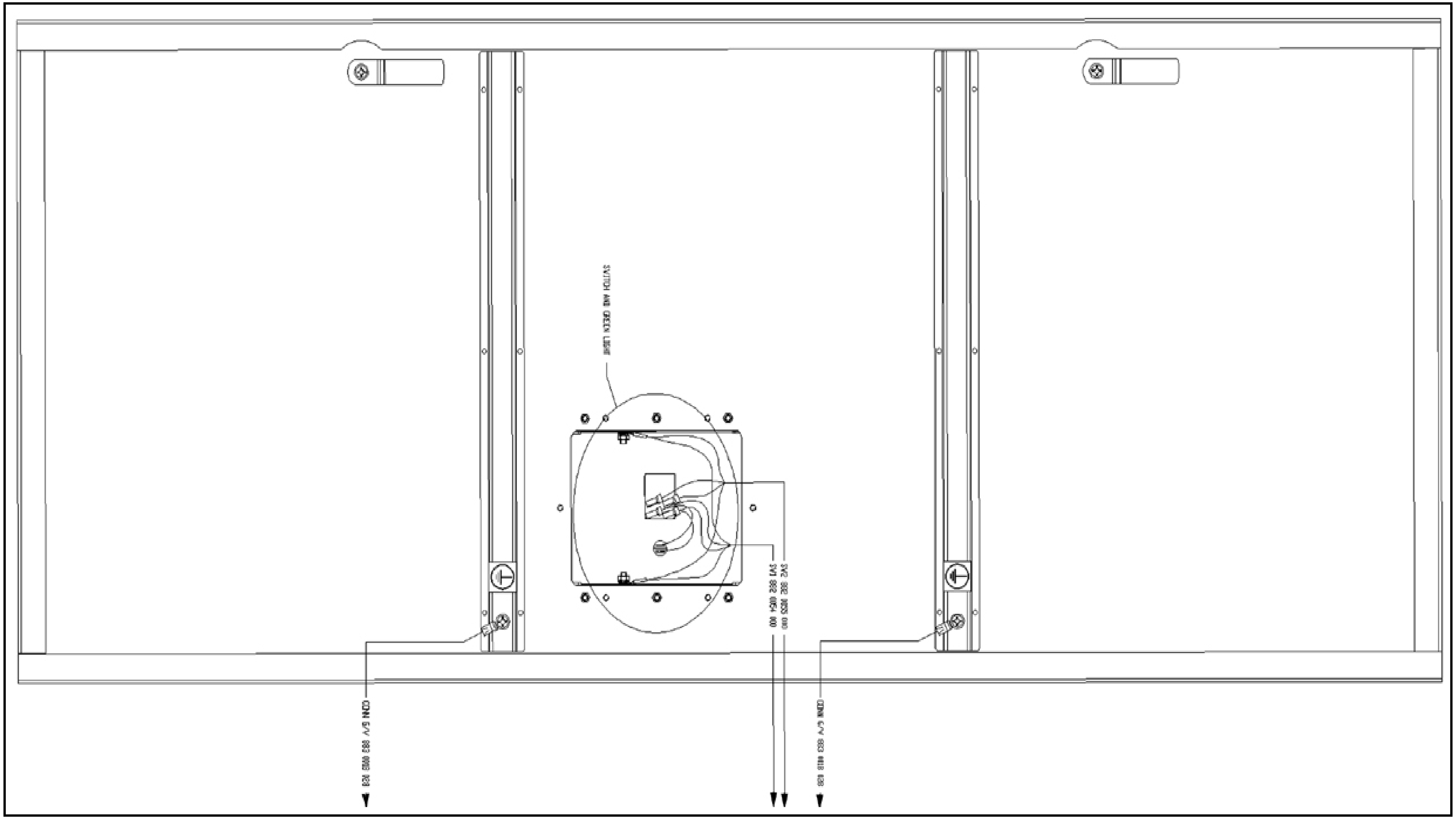


Fig. 5: *Electronic Unit (front side)*

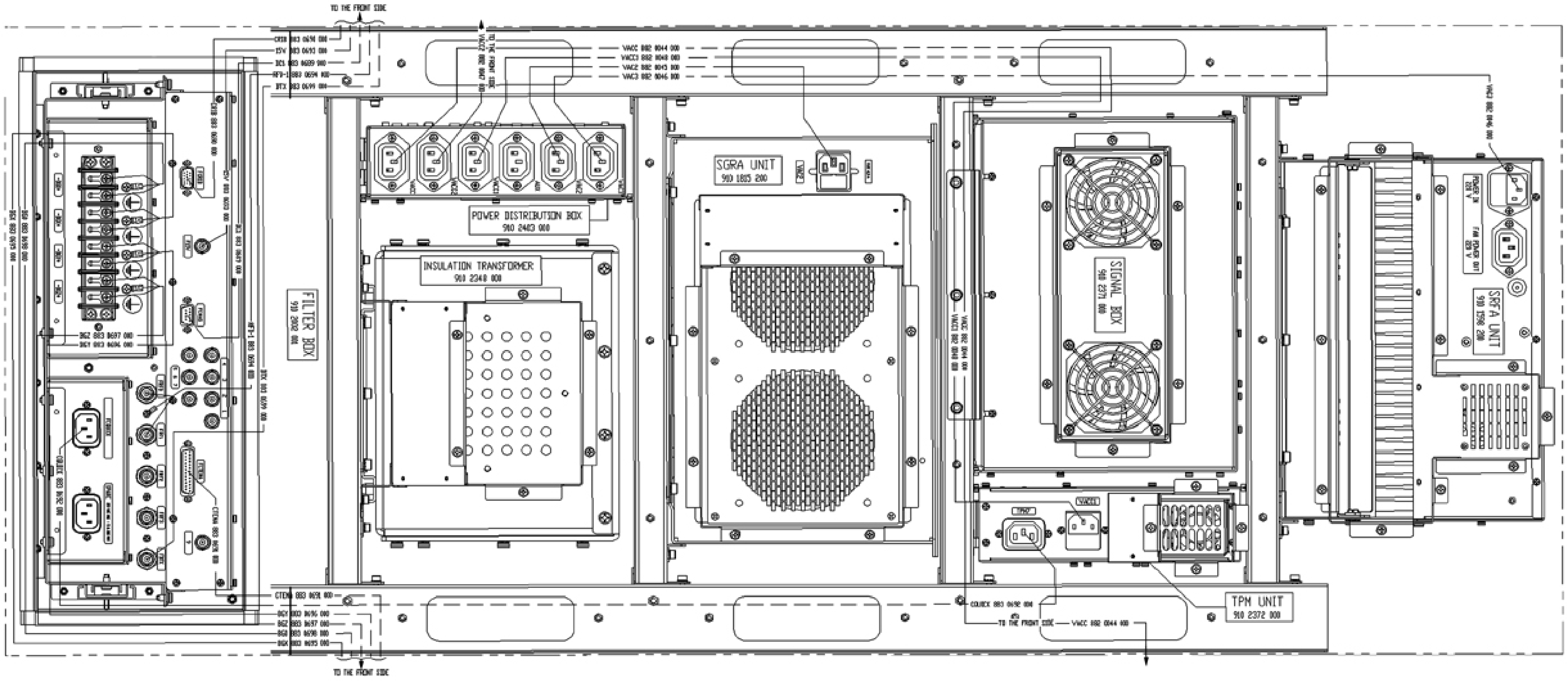


Fig. 6: Electronic Unit (rear side)

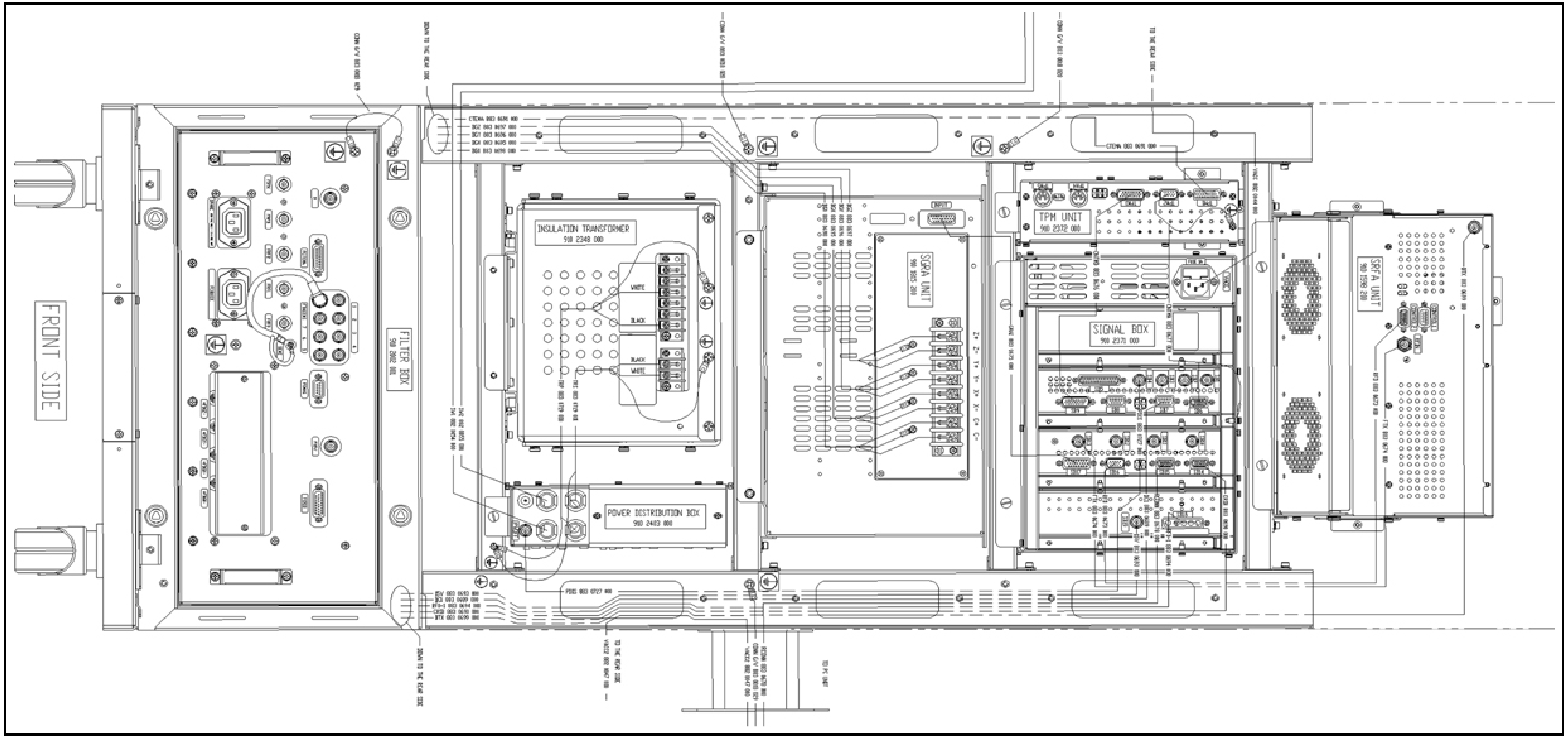
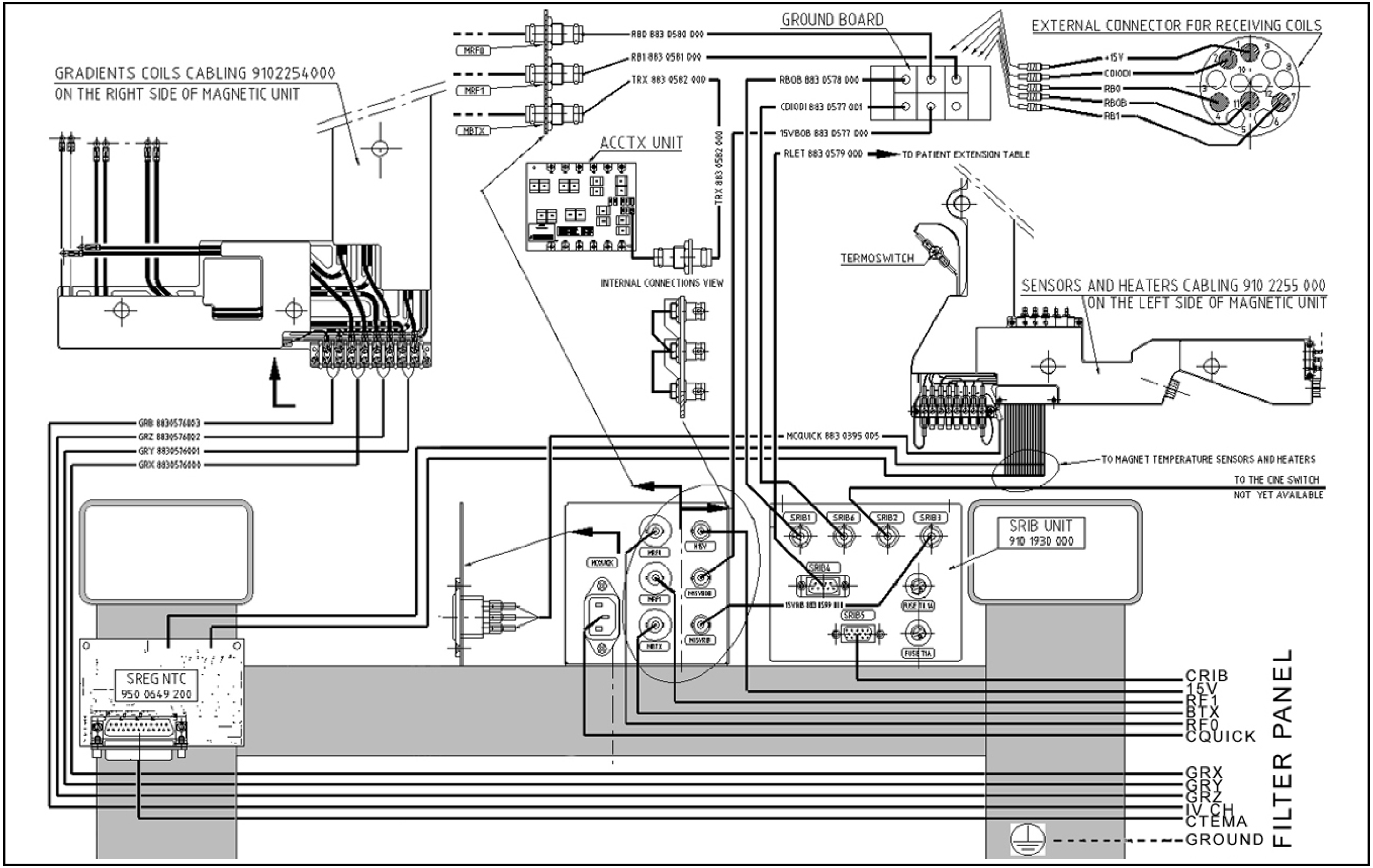


Fig. 7: *Magnet Rear Connection Panel and Cabling*



System Error Message List

Every error code is divided in three groups of number: x - xx - xxx.

The first group indicates the type of the error, the second group indicates the source and the third group indicates the probably broken part.

CAUTION **Please when you contact the ESAOTE Service Department for assistance communicate the complete error code!!!**

Type

- **“1” “Errors”** WARNING: there is a recoverable error and the user can continue to work; the operator must decide whether he wants to continue (button “Yes”) or not (button “No”). After this he exits the message window
- **“2” “Errors”** ERROR: the control is turned off and an unrecoverable error is indicated; the operator must click the “cancel” button to exit the message window
- **“3” “Syncs”** SYNC: is a synchronization message among the different software modules

Source

“0” LEGACY

“1” COI_SHELL

“2” AUTOTARAT

“3” NOISE_LEV

“4” TAR_MAX

“5” TAR_RF

“6” TARMAN

“7” TAUTO_FOV

“8” TGUAD_SWP

“9” VIEWTEMP

“10” NOISE_TEMP

“11” VIEWALARM

“12” TAR_CAMPO

“13” TAR_FREQ

“14” GRAD_DELAY

“15” TAR_FQOFFSET

“16” TAUTO_FOV_XYZ

“17” TAR_FIELD

“18” TAR_OFFGR

“19” RING

“20” COI_SERVER

“21” 4TH_CH_POL_SCRIPT

“22” MEASURE_EC

“23” ITER_EC

“24” BFIT_EC

“25” CURR_EC

“26” MIS_DIST_EST_EC

“27” FILLHEADER_EC

“28” SPECIFTAB_CLIENT_EC

“29” MOVERAWIMG_SCRIPT

“30” DELRAWIMG_SCRIPT

“31” RENAMERAWIMG_SCRIPT

“32” SETPREDEF_SCRIPT

“33” RESETPREDEF_SCRIPT

“34” SAVEPREDEF_SCRIPT

“35” COPYEDDYDIR_SCRIPT

“36” SAVETMPREC_SCRIPT

“37” COPYTMPARASREC_SCRIPT

“38” DWL_SERVER

“39” DSP_CLIENT

Error

NOTICE By selecting the **LogViewer** tab (bottom bar of OPI) it's possible to read which calibration or operation done by the System that caused the error

Tab. 2: Error List

Error	Message	Suggestions
1	Error in DSP-COI synchronization	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
2	No tune for this coil.	Try to perform these steps in this order: try another Coil, check the calibrations, check the receiving channel
3	Error reading predef file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
4	Error opening history file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
5	Error writing to DSP	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
6	Error in coi_constant configuration	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
7	Error reading tar class.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
8	Error reading from DSP	Try to perform these steps in this order: re-boot the system and check the DSPM unitization, change DSPM card, reload the software
9	Echoes number exceeds maximum.	Try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM

Error	**Message**	**Suggestions**
10	Incorrect Parameters.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
11	Error on execution.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
12	No signal on second echo.	Try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
13	Incorrect signal. The signal shape during calibration is not as required. Error; check the rec files.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
14	No signal during calibration.	Try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
15	Incorrect calibration	Try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
16	Anomalous number of trials during calibration	Try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
17	Signal with spikes and mean noise over threshold	Try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
18	Signal with noise. Mean noise calculated from fft signal is over threshold	Try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
19	Signal with spikes.	Try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
20	Number of required intersections cannot be obtained with zero. Check the rec files.	Try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM

Error	Message	Suggestions
21	Incorrect phantom position in X direction! Move towards magnet yoke, verify other directions, and restart procedure.	Check if the phantom is properly set if you are still not able to perform the calibration try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
22	Incorrect phantom position in X direction! Move towards magnet opening, verify other directions, and restart procedure.	Check if the phantom is properly set if you are still not able to perform the calibration try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
23	Incorrect phantom position in Y direction! Move towards magnet top side, verify other directions, and restart procedure.	Check if the phantom is properly set if you are still not able to perform the calibration try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
24	Incorrect phantom position in Y direction! Move towards magnet bottom side, verify other directions, and restart procedure.	Check if the phantom is properly set if you are still not able to perform the calibration try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
25	Incorrect phantom position in Z direction! Move towards F bed position, and restart procedure.	Check if the phantom is properly set if you are still not able to perform the calibration try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
26	Incorrect phantom position in Z direction! Move towards A bed position, and restart procedure.	Check if the phantom is properly set if you are still not able to perform the calibration try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
27	Incorrect signal. The max value of the signal after calibration is not within required range.	Try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
28	Incorrect temperature.	Try to perform these steps in this order: re-boot the system and try to repeat the Command/Operation that went wrong, check the System functionality, reload the software
29	Time-out on command delivery to DSP	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
30	Error in DSP timer synchronization	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software

Error	Message	Suggestions
31	Invalid command received from DSP	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
32	DSP timer initialization failed	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
33	Other instance of process present	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
34	Error opening file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
35	Invalid configuration parameter	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
36	Configuration parameter error	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
37	Wrong software switch condition	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
38	COM error	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
39	Error in DSP status	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
40	Error opening DSP	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
41	Error stopping DSP	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
42	Error downloading code to DSP	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software

Error	Message	Suggestions
43	Error starting DSP code	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
44	Wrong LIF command	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
45	Error reading file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
46	Signal saturation.	Try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
47	DSP overrun.	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
48	Error in DSP synchronization	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
49	Incorrect execution time sequence	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
50	Error initializing variables on DSP	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
51	Error writing to file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
52	Memory cannot be allocated.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
53	Error seeking file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
54	Error searching tokens in DSP tables.	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software

Error	Message	Suggestions
55	Error searching tokens in intermediate form.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
56	Dictionary index overflow.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
57	Wrong tarsca command option.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
58	Sequence not compiled correctly.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
59	Sequence must be compiled again.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
60	Source file name missing.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
61	Too many tokens on input line.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
62	Ambiguous file name.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
63	Error setting file attributes.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
64	Error copying files.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software

Error	Message	Suggestions
65	Wrong token name.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
66	Wrong loadvoc command option.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
67	Corrupted file, access denied.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
68	Vocabulary file terminator is missing.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
69	Error in dup().	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
70	Wrong vocabulary command	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
71	Wrong symbol	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
72	Dictionary of events overflow	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
73	Error in stat().	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
74	Error during execution of a LIF command.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
75	Error reading a string from DSP.	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software

Error	Message	Suggestions
76	Error loading CoiConstant dictionary.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
77	Error reloading CoiConstant dictionary.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
78	Vocabulary already loaded.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
79	Only first compilation phase succeeds (incorrect dump).	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
80	Error ordering intermediate form.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
81	Dictionary of variables overflow	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
82	Incorrect data file format	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
83	Input line is empty	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
84	Input token is too long	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
85	Question line is empty	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software

Error	Message	Suggestions
86	Predef dictionary overflow	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
87	Incorrect predef data file format	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
88	Predef value does not match configuration value	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
89	Error in check.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
90	Dsp generic error.	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
91	Error in Runtime starting.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
92	Error writing on pipe.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
93	Connection to coi_shell failed.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
94	Wrong MIF command	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
95	Error removing file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
96	WARNING Access Denied	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software

Error	Message	Suggestions
97	Error in shell.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
98	Error in file creation.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
99	Error in hiding sensitive data.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
100	Error in configuration.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
101	Incorrect range.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
102	Error in calculation.	Try to perform these steps in this order: check if the phantom is properly set, check if the AC and DC magnetic noises are correctly compensated performing the magnetic ghosting tests, repeat the ECC Tune, check the shimming parameters, reload the software.
103	Place 25 ml phantom in center of holder and insert in Knee coil (N. 2). When ready press 'Yes' to continue.	check if the phantom is properly set
104	Place small spherical phantom on holder and insert in Knee coil (N. 2). When ready press 'Yes' to continue.	check if the phantom is properly set
105	End of Gradient Offset calibration.	Try to perform these steps in this order: check the Magnet Temperature, check Magnet Heaters and Sensors resistor values, change TMP and or MTCM
106	End of ECC Tune calibration. Check results against specifications.	End of ECC Tune calibration. Check results against specifications.

Error	Message	Suggestions
107	End of ECC Check. Verify results against specifications.	End of ECC Check. Verify results against specifications.
108	Incorrect 4th channel polarity.	The polarity of the 4th channel is incorrect: check the 4th channel gradient cables looking for any inversion.
109	The 4th channel polarity is correct. WARNING: before running ECC Tune, verify and/or modify the configuration of the 4th channel and pole plate.	The polarity of the 4th channel is correct but the value used to perform the SGRA calibration is incorrect: check the magnet IC setting in the IE hardware configuration page of the SERV user.
110	The 4th channel polarity is correct.	Correct 4th channel polarity.
111	The 4th channel polarity is correct. WARNING: before running ECC Tune, verify and/or modify the configuration of the 4th channel and pole plate.	The polarity of the 4th channel is correct but the value used to perform the SGRA calibration is incorrect: check the magnet IC setting in the IE hardware configuration page of the SERV user.
112	Scan cannot run.	Try to perform these steps in this order: re-boot the system and try to repeat the Command/Operation that went wrong, check the System functionality, reload the software
113	Incorrect executable.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
114	Ring current calibration is not in specification for channel X.	The automatic calibration of the X gradient input signal is not correct: verify the SGRA functionality, the DSCPU or ACM functionality and the gradient cable connections
115	Ring current calibration is not in specification for channel Y.	The automatic calibration of the Y gradient input signal is not correct: verify the SGRA functionality, the DSCPU or ACM functionality and the gradient cable connections
116	Ring current calibration is not in specification for channel Z.	The automatic calibration of the Z gradient input signal is not correct: verify the SGRA functionality, the DSCPU or ACM functionality and the gradient cable connections

Error	Message	Suggestions
117	Ring current calibration is not in specification for 4th channel.	The automatic calibration of the 4th channel gradient input signal is not correct: verify the SGRA functionality, the DSCPU or ACM functionality and the gradient cable connections
118	Ring current calibration is in specification for channel X.	The automatic calibration of the X channel gradient input signal is correct
119	Ring current calibration is in specification for channel Y.	The automatic calibration of the Y channel gradient input signal is correct
120	Ring current calibration is in specification for channel Z.	The automatic calibration of the Z channel gradient input signal is correct
121	Ring current calibration is in specification for 4th channel.	The automatic calibration of the 4th channel gradient input signal is correct
122	Stop state of GRA detected during regulator calibration for X channel.	current oscillation detected by the system during the automatic calibration of the X gradient output signal. if the calibration doesn't restart automatically verify the SGRA functionality and gradient cable connections.
123	Stop state of GRA detected during regulator calibration for Y channel.	current oscillation detected by the system during the automatic calibration of the Y gradient output signal. if the calibration doesn't restart automatically verify the SGRA functionality and gradient cable connections.
124	Stop state of GRA detected during regulator calibration for Z channel.	current oscillation detected by the system during the automatic calibration of the Z gradient output signal. if the calibration doesn't restart automatically verify the SGRA functionality and gradient cable connections.
125	Stop state of GRA detected during regulator calibration for 4 channel.	gradient current oscillation detected by the system during the automatic calibration of the 4th channel gradient output signal. if the calibration doesn't restart automatically verify the SGRA functionality and gradient cable connections.
126	Unstable state of GRA detected during regulator calibration for X channel.	current oscillation detected by the system during the automatic calibration of the X gradient input signal. if the calibration doesn't restart automatically verify the SGRA functionality and gradient cable connections.
127	Unstable state of GRA detected during regulator calibration for Y channel.	current oscillation detected by the system during the automatic calibration of the Y gradient input signal. if the calibration doesn't restart automatically verify the SGRA functionality and gradient cable connections.
128	Unstable state of GRA detected during regulator calibration for Z channel.	current oscillation detected by the system during the automatic calibration of the Z gradient input signal. if the calibration doesn't restart automatically verify the SGRA functionality and gradient cable connections.

Error	Message	Suggestions
129	Unstable state of GRA detected during regulator calibration for 4 channel.	gradient current oscillation detected by the system during the automatic calibration of the 4th channel gradient input signal. if the calibration doesn't restart automatically verify the SGRA functionality and gradient cable connections.
130	Incorrect exit code.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
131	Incorrect signal during Eddy Current measurement analysis.	Try to perform these steps in this order: check if the phantom is properly set, check if the AC and DC magnetic noises are correctly compensated performing the magnetic ghosting tests, repeat the ECC Tune, check the shimming parameters, reload the software.
132	Anomalous signal during Eddy Current Tune. Press 'No' to stop and save System Configuration if not already done, otherwise press 'Yes' to continue.	Try to perform these steps in this order: check if the phantom is properly set, check if the AC and DC magnetic noises are correctly compensated performing the magnetic ghosting tests, repeat the ECC Tune, check the shimming parameters, reload the software.
133	Anomalous signal during Eddy Current measurement analysis.	Try to perform these steps in this order: check if the phantom is properly set, check if the AC and DC magnetic noises are correctly compensated performing the magnetic ghosting tests, repeat the ECC Tune, check the shimming parameters, reload the software.
134	Anomalous compensation during Eddy Current Tune. Press 'No' to stop and save System Configuration if not already done, otherwise press 'Yes' to continue.	Try to perform these steps in this order: check if the phantom is properly set, check if the AC and DC magnetic noises are correctly compensated performing the magnetic ghosting tests, repeat the ECC Tune, check the shimming parameters, reload the software.
135	Signal phase stability outside specification: check EFI DC compensation. Proceed anyway?	Try to perform these steps in this order: check if the phantom is properly set, check if the AC and DC magnetic noises are correctly compensated performing the magnetic ghosting tests, repeat the ECC Tune, check the shimming parameters, reload the software.
136	Scan disabled.	Try to perform these steps in this order: re-boot the system and try to repeat the Command/Operation that went wrong, check the System functionality, reload the software
137	Scan disabled. System call error.	Try to perform these steps in this order: re-boot the system and try to repeat the Command/Operation that went wrong, check the System functionality, reload the software

Error	Message	Suggestions
138	Scan disabled. Configuration file error.	Try to perform these steps in this order: re-boot the system and try to repeat the Command/Operation that went wrong, check the System functionality, reload the software
139	Error in reading data file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
140	CoiConstant symbol not found.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
141	Wrong file format.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
142	Wrong DSP multiplexer selection	Try to perform these steps in this order: re-boot the system and check the DSPM initialization, change DSPM card, reload the software
143	Generic error.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
144	Error reading path.xml file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
145	File or folder nonexistent.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
146	File not renamed.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
147	Error loading dat file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
148	Error moving file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software

Error	Message	Suggestions
149	Change not saved on file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
150	Error copying file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
151	Error deleting file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
152	Error cutting file.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
153	Error loading ARAS_VARPATH_FILE.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
154	Error starting PaperRec.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software
155	start Message not received.	Try to perform these steps in this order: follow the SW suggestions if present into the shown message, check the Phantom position and Coil connection, re-boot the system try to repeat the Calibration that went wrong, check the System functionality (e.g.: perform the System Check), reload the software

Error	Message	Suggestions
156	Hardware error	Try to perform these steps in this order: re-boot the system and repeat the Command/Operation that went wrong, check the functionality of the module indicated in the error message – SGRA failure (wrong SGRA power supply): check the magnet temperature, system connections and system check, try to replace the module – MTCM and TPM failure: check the led status, check the system functionality and system connections, try to replace the module – ACM failure and watchdog alarm (alarm from watchdog of dsprf/dspgr on ACM): check the led status, check the system functionality (e.g.: system check) and system connections, try to replace the module – RFM failure: perform the homogeneity test and check the receiving channel, check the system functionality and system connections, try to replace the module – RFA failure (mean current too high or excessive direct or reflected power or temperature overload): check the led status, check the system functionality (e.g.: system check and TX coil test) and system connections, try to replace the module
157	Error merging ECC raw data	Try to perform these steps in this order: re-boot the system and try to repeat the Command/Operation that went wrong, check the System functionality, reload the software
158	Join the RFIN cable and the RFOUT cable using a 'I' BNC connector. Connect the 'T' BNC connector to the FBTX coaxial connector and the two RG58 cables to the FRF0 and FRF1 coaxial connectors	Try to perform these steps in this order: re-boot the system and try to repeat the Command/Operation that went wrong, check the System functionality, reload the software
65535	Msg UNKNOWN_ERR, unknown error	Try to perform these steps in this order: re-boot the system and try to repeat the Command/Operation that went wrong, check the System functionality, reload the software

Troubleshooting

Some criteria to be followed in identifying the module that needs replacing in the event of a malfunction are described below.

A malfunction involving the CPU, HD, SVGA, monitor, keyboard, mouse and optical disc should be immediately obvious since their operation (or failure) is plainly “visible”.

If the message “Non recoverable error. Scan disabled” appears this means that the software has found problems with one of the Digital Signal Processor modules (DSPM). Repeat the bootstrap and carefully check if WIN2000 has started. The only correct messages relative the DSPM are the correct ones:

- “DSP0 (or 1) initialization done”

Instead if the following messages appear, the DSPM needs replacing:

- “Test memory failed”
- “DSP0 (or 1) not present at address 0 x 360"

If the bootstrap routine was completed successfully, you are advised to run the alarm diagnostics. With this procedure, you can check whether amplifiers (SGRA and SRFA) and MTCM and TPM are operating correctly. In the event of a malfunction, a message appears identifying the failed module. The acronyms used have the following meanings:

- SGRA-OFF: direct power supply failure to the gradient amplifier. This event may also be due (besides to the fuse being blown, or a disconnected 220 V AC cable etc.) to failure to receive acknowledgement from the MTCM (or TPM) module.
- SGRA: gradient amplifier malfunction (failed PLL connection of its internal switching amplifier and/or output voltage clamp). Not significant when SGRA-OFF is present.
- SRFA-OFF: direct power supply failure to the RF amplifier. This event may also be due (as well as to the fuse being blown, or disconnected 220 V AC cable etc.) to overheating of the amplifier (T > 50 °C).
- SRFA: RF amplifier malfunctioning (duty cycle over 25% and/or reflected power greater than 40 watt). Not significant when SRFA-OFF is present.
- MTCM and TPM: direct power supply failure to the MTCM (or TPM) module. This event may also be due (as well as to the fuse being blown or to a disconnected 220 V AC-cable etc.) to overheating of at least one side of the magnet. This failure is detected by the temperature sensors (2 NTC in series) located on the side, or by a short circuit or an open circuit on at least one of the four groups of the NTC sensors.

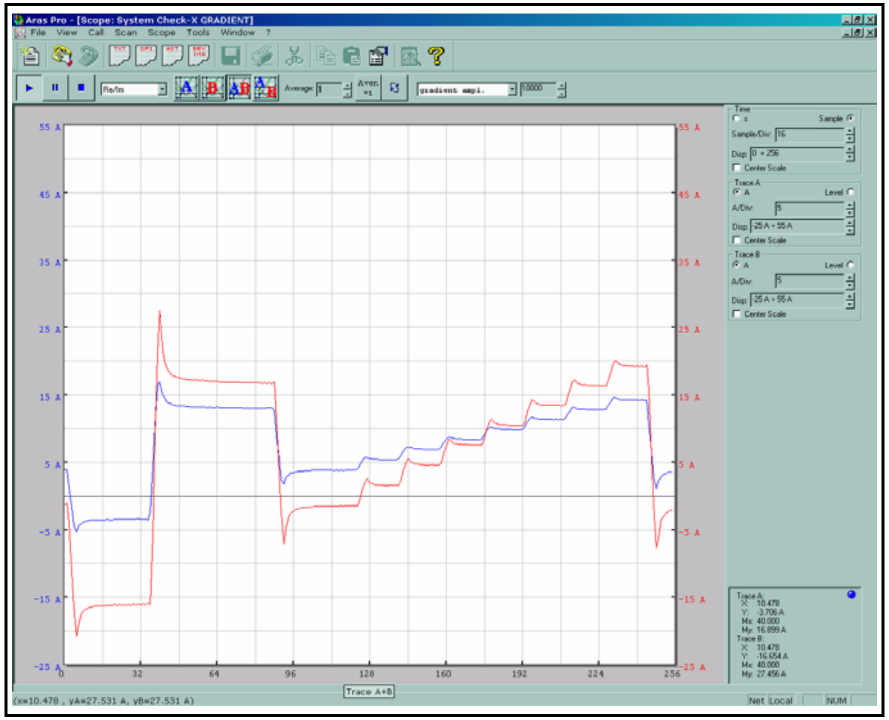
After verifying that the standard part of the PC (successful completion of the bootstrap routine without any error messages) and the power modules (SGRA, SRFA, MTCM and TPM are operating correctly, with the diagnostic alarms), you can proceed to run the **<System Check>** diagnostic.

If the plot operates correctly, it is safe to assume that, generally speaking, the control subsystems (MTCM) and the acquisition subsystems (ACM) are operating correctly too.

In particular, it is best to first display the values relative to the driving of the receiving subsystem (modules RFM and ACM) which are generated and monitored from within the module ACM.

Their correct behavior confirms substantially that acquisition is operating correctly.

Fig. 8: System Check, X Gradient



Aras Pro - [Scope: System Check-X GRADIENT]

Re/Im

Average: 1

gradient ampl.

10000

Time: Sample ●
Sample/Div: 16
Disp: 0 ÷ 256
☐ Center Scale

Trace A: ● A
A/Div: 5
Disp: -25 A ÷ 55 A
☐ Center Scale

Trace B: ● A
A/Div: 5
Disp: -25 A ÷ 55 A
☐ Center Scale

Trace A:
X: 10.478
Y: -3.706 A
Mx: 40.000
My: 16.899 A
Trace B:
X: 10.478
Y: -16.654 A
Mx: 40.000
My: 27.456 A

(x=10.478 , yA=27.531 A, yB=27.531 A)

From <**System Check**> you can also verify the correct operation of “Gradients” and “RF Pulse”. Regarding the RF pulse, you must know the correct amplitude ratio between transmitted and reflected RF pulse (Pd/Pr>4) which shows that the connection is correct and that the transmitting coil (BTX) tuning is correct. Conversely, the absence of the RF pulse may be due to:

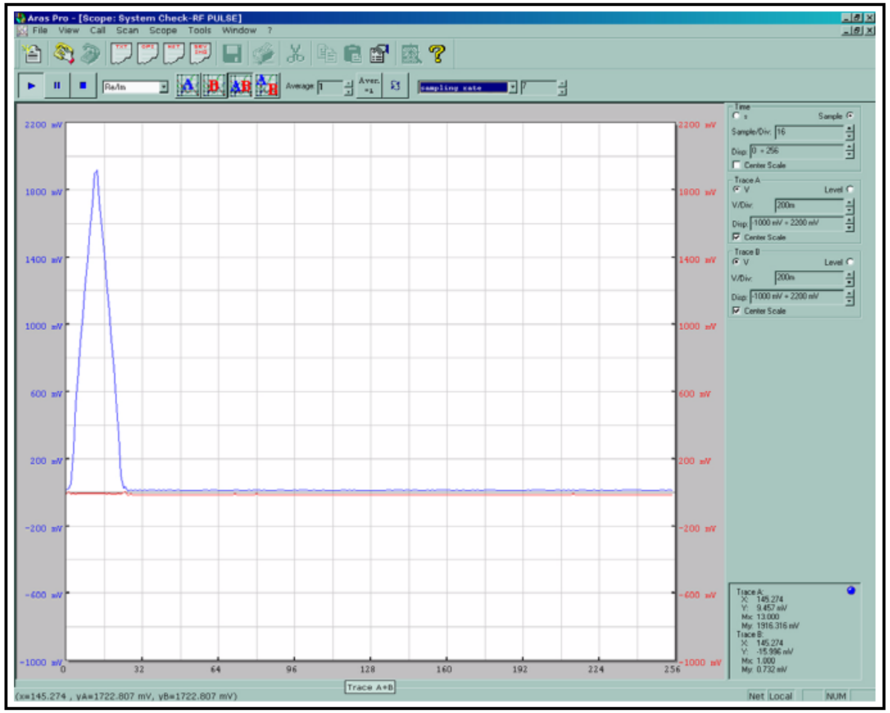
A malfunction of the ACM module: if, for instance, the module is not receiving power (fuse, cable, etc.).

Bad tuning of the transmitting coil. If the ratio is about 1 (i.e. all the power is reflected), the problem could be due to a bad connection between RF amplifier and transmitting coil or a broken component inside the transmitting coil. For example the central capacitor on the tuning circuit inside the “gantry”.

A wrong value of the frequency set in the “Homogeneity” calibration.

As for the receiving chain, you are advised to use the standard machine settings (central frequency search, noise level, S/N for the various receiving coil and sequence calibration, etc.).

Fig. 9: System Check, TX Pulses (direct and reflected power)



Aras Pro - [Scope: System Check-RF PULSE]

Re/Im

Average: 1

sampling rate

7

Time: Sample ●
Sample/Div: 16
Disp: 0 ÷ 256
☐ Center Scale

Trace A: ● V
V/Div: 200m
Disp: -1000 mV ÷ 2200 mV
☑ Center Scale

Trace B: ● V
V/Div: 200m
Disp: -1000 mV ÷ 2200 mV
☑ Center Scale

Trace A:
X: 145.274
Y: 9.457 mV
Mx: 13.000
My: 1916.316 mV
Trace B:
X: 145.274
Y: -15.996 mV
Mx: 1.000
My: 0.732 mV

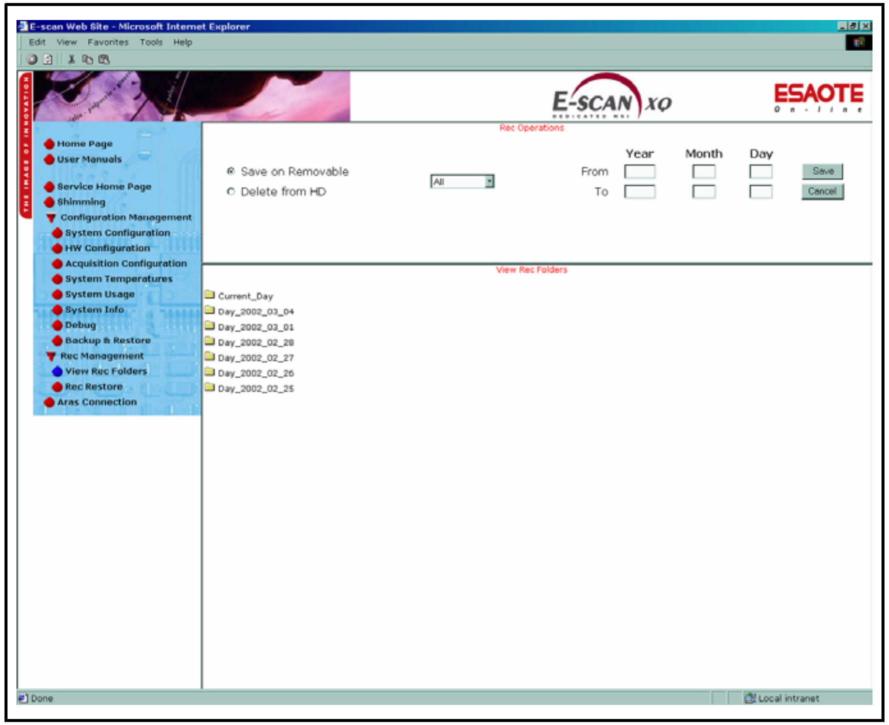
(x=145.274 , yA=1722.807 mV, yB=1722.807 mV)

Procedures

Recording files introduction

This section explains the possibility of evaluating information regarding the system operations. In fact this information is written in some recording files which can be seen by the operator. The following paragraph gives the recording files list, in which the name of every file is followed by an extension name “.rec”.

Fig. 10: View Rec Folder Page



● Save on Removable
○ Delete from HD
All

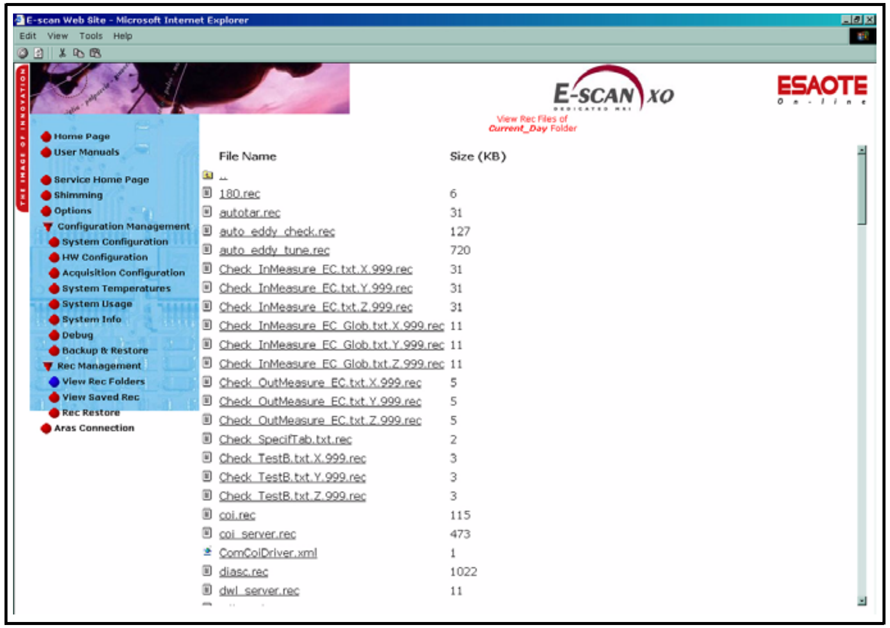
View Rec Folders

Current_Day
Day_2002_03_04
Day_2002_03_01
Day_2002_02_28
Day_2002_02_27
Day_2002_02_26
Day_2002_02_25

The Rec Files contain all the operations performed by the system. Some of them are generic other are more specific. The system creates a new folder every day and every folder contain only the rec files filled in that day. If one calibration or test is not done the corresponding Rec file is not created.

All the rec files are self-explaining and not always are created by the system every day. To have access to the rec files, open the Internet Explorer and, from the homepage, open the **Rec File Management** folder then **View Rec Folder**: from this page you have to select the interested day, opening it the system will show the compiled rec files.

Fig. 11: REC File of one working day



View Rec Files of *Current_Day* Folder

File Name	Size (KB)
..	
180.rec	6
autotar.rec	31
auto_eddy_check.rec	127
auto_eddy_tune.rec	720
Check_InMeasure_EC.txt.X.999.rec	31
Check_InMeasure_EC.txt.Y.999.rec	31
Check_InMeasure_EC.txt.Z.999.rec	31
Check_InMeasure_EC_Glob.txt.X.999.rec	11
Check_InMeasure_EC_Glob.txt.Y.999.rec	11
Check_InMeasure_EC_Glob.txt.Z.999.rec	11
Check_OutMeasure_EC.txt.X.999.rec	5
Check_OutMeasure_EC.txt.Y.999.rec	5
Check_OutMeasure_EC.txt.Z.999.rec	5
Check_SpecifTab.txt.rec	2
Check_TestB.txt.X.999.rec	3
Check_TestB.txt.Y.999.rec	3
Check_TestB.txt.Z.999.rec	3
coi.rec	115
coi_server.rec	473
ComCoilDriver.xml	1
diasc.rec	1022
dwl_server.rec	11

Rec file list

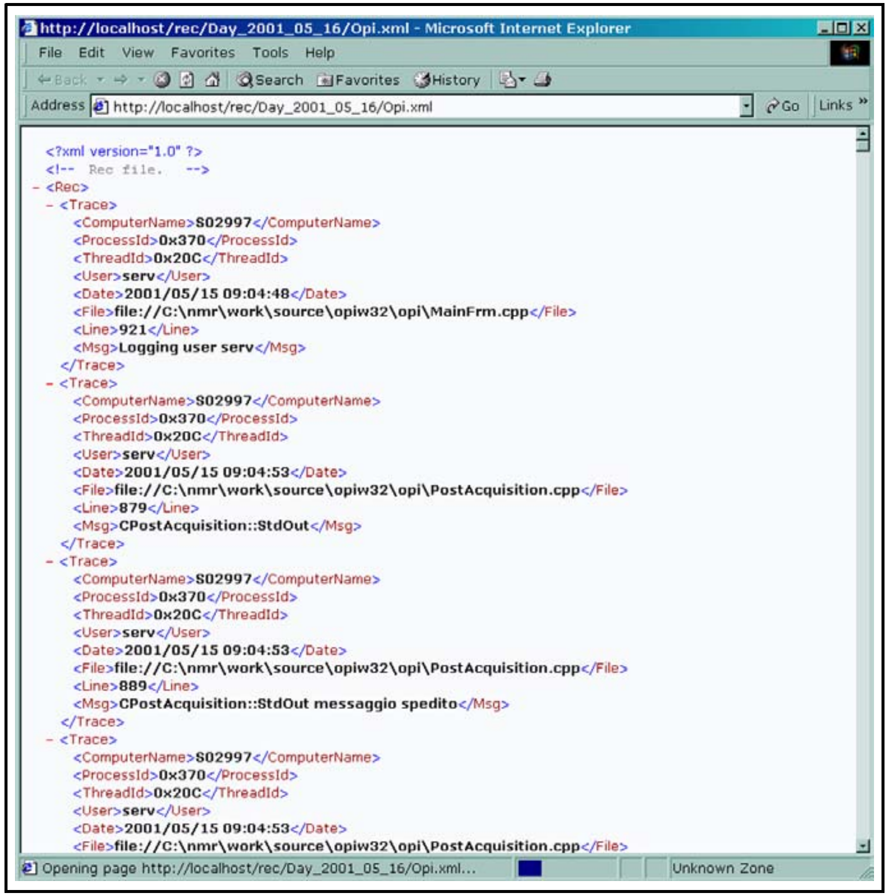
Tab. 3: Rec file list (alphabetic order)

Rec file name	Meaning
180.rec	The file contains the 180 pulse values
alarms.rec	Alarm messages are stored in this file
auto_eddy.rec	The file contains the SGRA calibration data
autotar.rec	This file contains information about two different gain processes
coi.rec	The file keeps a record of the activity of every work session of the *Control Interface* (*COI)*
fov.rec	The dimensions along the Y and X-axes of the object are stored in this file
freq.rec	The file contains the course and fine step frequency values
freq_fine.rec	The file contains the fine step frequency values
f_q_offset.rec	The file contains the RX Offset values
gdelay.rec	The file contains the Gradient Delay values
noise.rec	The file contains the shielding test values
offgr.rec	The file contains the Gradient Offset values
opi.rec	The file contains all the sentences written by the Operator Interface (*OPI*) during the examination
opicoi.rec	The file contains information about the **core** file
opierr.rec	The file contains the sentences written every time an Error Message Window is displayed
regulators.rec	The file contains the SGRA input values
results.rec	The file contains the data of the shimming calculation
ring_out_4.rec	The file contains the SGRA 4th CH output values
ring_out_x.rec	The file contains the SGRA X CH output values
ring_out_y.rec	The file contains the SGRA Y CH output values
ring_out_z.rec	The file contains the SGRA Z CH output values
shim_hist.rec	The file contains all the shimming results
sn.rec	The file contains the <**S/N Check**> obtained by pressing a button from the Operator Interface
temp.rec	The file contains the temperature and power values of the magnet
varicap.rec	The file contains the varicap The file contains the 180 pulse values
Work.rec	The file is the trace of the general activity of the machine (working data)

Opi.xml

This file contains all the operations performed by the system from the switch on to the switch off. This file is useful to check improperly shutdown for example (done by the operator or by software bugs).

Fig. 12: Opi.xml

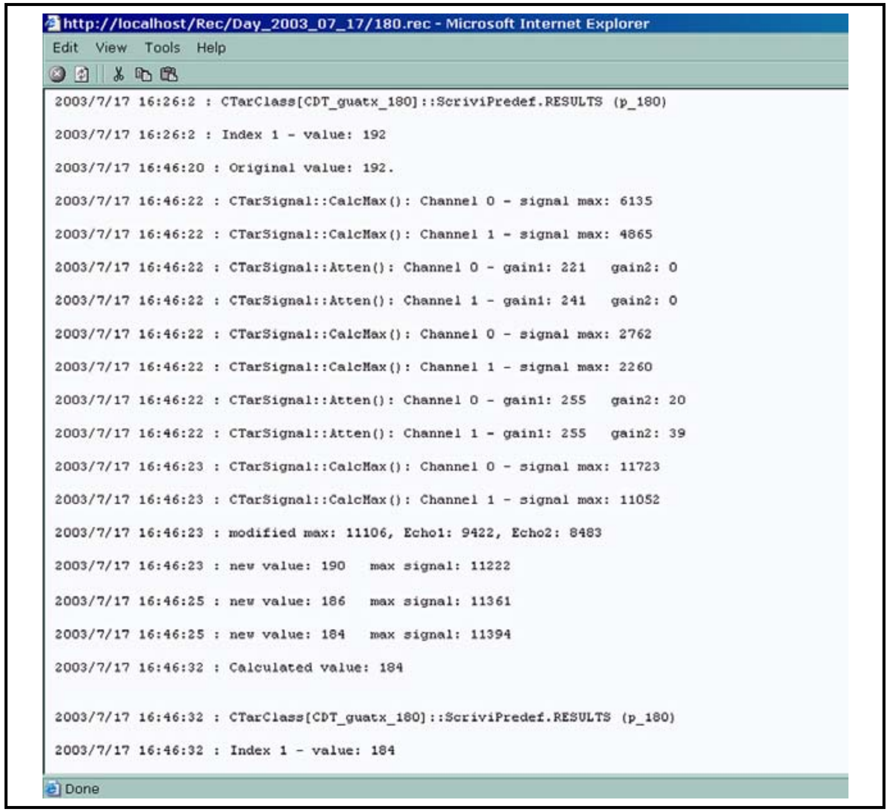

http://localhost/rec/Day_2001_05_16/Opi.xml - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
History
Address
http://localhost/rec/Day_2001_05_16/Opi.xml
Go
Links
Opening page http://localhost/rec/Day_2001_05_16/Opi.xml...
Unknown Zone

```xml
  <?xml version="1.0" ?>
  <!--  Rec file.   -->
- <Rec>
  - <Trace>
      <ComputerName>S02997</ComputerName>
      <ProcessId>0x370</ProcessId>
      <ThreadId>0x20C</ThreadId>
      <User>serv</User>
      <Date>2001/05/15 09:04:48</Date>
      <File>file://C:\nmr\work\source\opiw32\opi\MainFrm.cpp</File>
      <Line>921</Line>
      <Msg>Logging user serv</Msg>
    </Trace>
  - <Trace>
      <ComputerName>S02997</ComputerName>
      <ProcessId>0x370</ProcessId>
      <ThreadId>0x20C</ThreadId>
      <User>serv</User>
      <Date>2001/05/15 09:04:53</Date>
      <File>file://C:\nmr\work\source\opiw32\opi\PostAcquisition.cpp</File>
      <Line>879</Line>
      <Msg>CPostAcquisition::StdOut</Msg>
    </Trace>
  - <Trace>
      <ComputerName>S02997</ComputerName>
      <ProcessId>0x370</ProcessId>
      <ThreadId>0x20C</ThreadId>
      <User>serv</User>
      <Date>2001/05/15 09:04:53</Date>
      <File>file://C:\nmr\work\source\opiw32\opi\PostAcquisition.cpp</File>
      <Line>889</Line>
      <Msg>CPostAcquisition::StdOut messaggio spedito</Msg>
    </Trace>
  - <Trace>
      <ComputerName>S02997</ComputerName>
      <ProcessId>0x370</ProcessId>
      <ThreadId>0x20C</ThreadId>
      <User>serv</User>
      <Date>2001/05/15 09:04:53</Date>
      <File>file://C:\nmr\work\source\opiw32\opi\PostAcquisition.cpp</File>
```

180.rec

The 180° Pulse calibration is automatically done by the system every scout acquisition to calibrate the necessary energy to rotate the spin during the sequence acquisition. The 90° Pulse is automatically calculated by the system starting from the 180° Pulse value. The 180.rec file is also filled in during the Service automatic calibrations. Looking at this file is possible to understand when the system wasn't able to calibrate the pulse and why the images went black, for example.

Fig. 13: 180.rec


http://localhost/Rec/Day_2003_07_17/180.rec - Microsoft Internet Explorer
Edit View Tools Help
Done

```
2003/7/17 16:26:2 : CTarClass[CDT_guatx_180]::ScriviPredef.RESULTS (p_180)

2003/7/17 16:26:2 : Index 1 - value: 192

2003/7/17 16:46:20 : Original value: 192.

2003/7/17 16:46:22 : CTarSignal::CalcMax(): Channel 0 - signal max: 6135

2003/7/17 16:46:22 : CTarSignal::CalcMax(): Channel 1 - signal max: 4865

2003/7/17 16:46:22 : CTarSignal::Atten(): Channel 0 - gain1: 221   gain2: 0

2003/7/17 16:46:22 : CTarSignal::Atten(): Channel 1 - gain1: 241   gain2: 0

2003/7/17 16:46:22 : CTarSignal::CalcMax(): Channel 0 - signal max: 2762

2003/7/17 16:46:22 : CTarSignal::CalcMax(): Channel 1 - signal max: 2260

2003/7/17 16:46:22 : CTarSignal::Atten(): Channel 0 - gain1: 255   gain2: 20

2003/7/17 16:46:22 : CTarSignal::Atten(): Channel 1 - gain1: 255   gain2: 39

2003/7/17 16:46:23 : CTarSignal::CalcMax(): Channel 0 - signal max: 11723

2003/7/17 16:46:23 : CTarSignal::CalcMax(): Channel 1 - signal max: 11052

2003/7/17 16:46:23 : modified max: 11106, Echo1: 9422, Echo2: 8483

2003/7/17 16:46:23 : new value: 190   max signal: 11222

2003/7/17 16:46:25 : new value: 186   max signal: 11361

2003/7/17 16:46:25 : new value: 184   max signal: 11394

2003/7/17 16:46:32 : Calculated value: 184


2003/7/17 16:46:32 : CTarClass[CDT_guatx_180]::ScriviPredef.RESULTS (p_180)

2003/7/17 16:46:32 : Index 1 - value: 184
```

Freq.rec

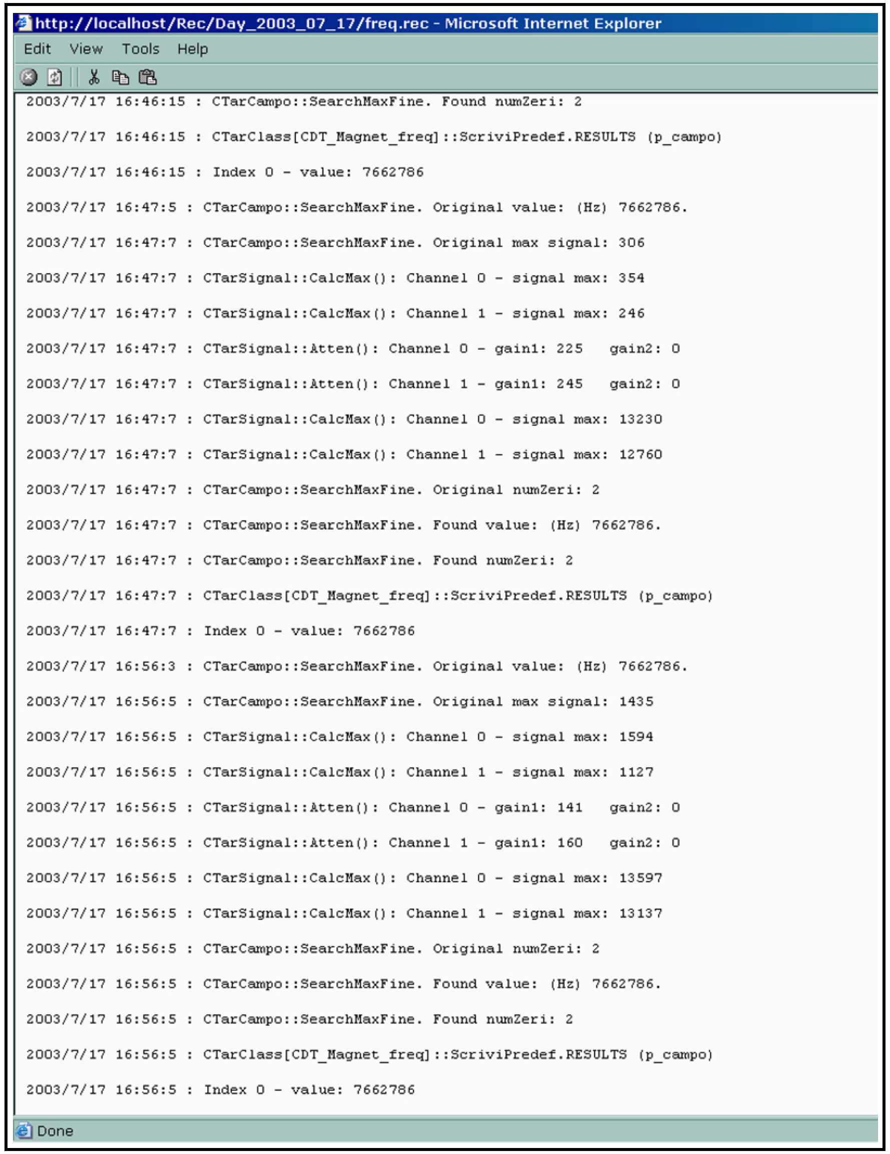
Like for the 180.rec, the frequency calibration is automatically done by the system every scout acquisition to find the magnet frequency in that moment. A small frequency shift is normal and compensated by the system.

A frequency shift usually is related to a thermal shift, usually, due to the environmental thermal shift. During the day the temperature of the room increase and the MTCM (or TPM) has to follow this shift decreasing the power sent to the Magnet to warm up it.

In case of big Magnet thermal shift, perform the System Monitor to follow in real time the temperature and provided power to every channel.

Remember that the system is calibrated to the Magnet central frequency and it must be stable, all the specification written in the Planning Guide and related to the installation room must be met. Stable frequency means good image quality.

Fig. 14: Freq.rec



http://localhost/Rec/Day_2003_07_17/freq.rec - Microsoft Internet Explorer
Edit
View
Tools
Help
Done

```
2003/7/17 16:46:15 : CTarCampo::SearchMaxFine. Found numZeri: 2

2003/7/17 16:46:15 : CTarClass[CDT_Magnet_freq]::ScriviPredef.RESULTS (p_campo)

2003/7/17 16:46:15 : Index 0 - value: 7662786

2003/7/17 16:47:5 : CTarCampo::SearchMaxFine. Original value: (Hz) 7662786.

2003/7/17 16:47:7 : CTarCampo::SearchMaxFine. Original max signal: 306

2003/7/17 16:47:7 : CTarSignal::CalcMax(): Channel 0 - signal max: 354

2003/7/17 16:47:7 : CTarSignal::CalcMax(): Channel 1 - signal max: 246

2003/7/17 16:47:7 : CTarSignal::Atten(): Channel 0 - gain1: 225   gain2: 0

2003/7/17 16:47:7 : CTarSignal::Atten(): Channel 1 - gain1: 245   gain2: 0

2003/7/17 16:47:7 : CTarSignal::CalcMax(): Channel 0 - signal max: 13230

2003/7/17 16:47:7 : CTarSignal::CalcMax(): Channel 1 - signal max: 12760

2003/7/17 16:47:7 : CTarCampo::SearchMaxFine. Original numZeri: 2

2003/7/17 16:47:7 : CTarCampo::SearchMaxFine. Found value: (Hz) 7662786.

2003/7/17 16:47:7 : CTarCampo::SearchMaxFine. Found numZeri: 2

2003/7/17 16:47:7 : CTarClass[CDT_Magnet_freq]::ScriviPredef.RESULTS (p_campo)

2003/7/17 16:47:7 : Index 0 - value: 7662786

2003/7/17 16:56:3 : CTarCampo::SearchMaxFine. Original value: (Hz) 7662786.

2003/7/17 16:56:5 : CTarCampo::SearchMaxFine. Original max signal: 1435

2003/7/17 16:56:5 : CTarSignal::CalcMax(): Channel 0 - signal max: 1594

2003/7/17 16:56:5 : CTarSignal::CalcMax(): Channel 1 - signal max: 1127

2003/7/17 16:56:5 : CTarSignal::Atten(): Channel 0 - gain1: 141   gain2: 0

2003/7/17 16:56:5 : CTarSignal::Atten(): Channel 1 - gain1: 160   gain2: 0

2003/7/17 16:56:5 : CTarSignal::CalcMax(): Channel 0 - signal max: 13597

2003/7/17 16:56:5 : CTarSignal::CalcMax(): Channel 1 - signal max: 13137

2003/7/17 16:56:5 : CTarCampo::SearchMaxFine. Original numZeri: 2

2003/7/17 16:56:5 : CTarCampo::SearchMaxFine. Found value: (Hz) 7662786.

2003/7/17 16:56:5 : CTarCampo::SearchMaxFine. Found numZeri: 2

2003/7/17 16:56:5 : CTarClass[CDT_Magnet_freq]::ScriviPredef.RESULTS (p_campo)

2003/7/17 16:56:5 : Index 0 - value: 7662786
```

Varicap.rec

The Varicap is a voltage value (0 - 9 V) sent by the RFM to the Coil in order to set it to the Magnet frequency taking care of the inserted load.

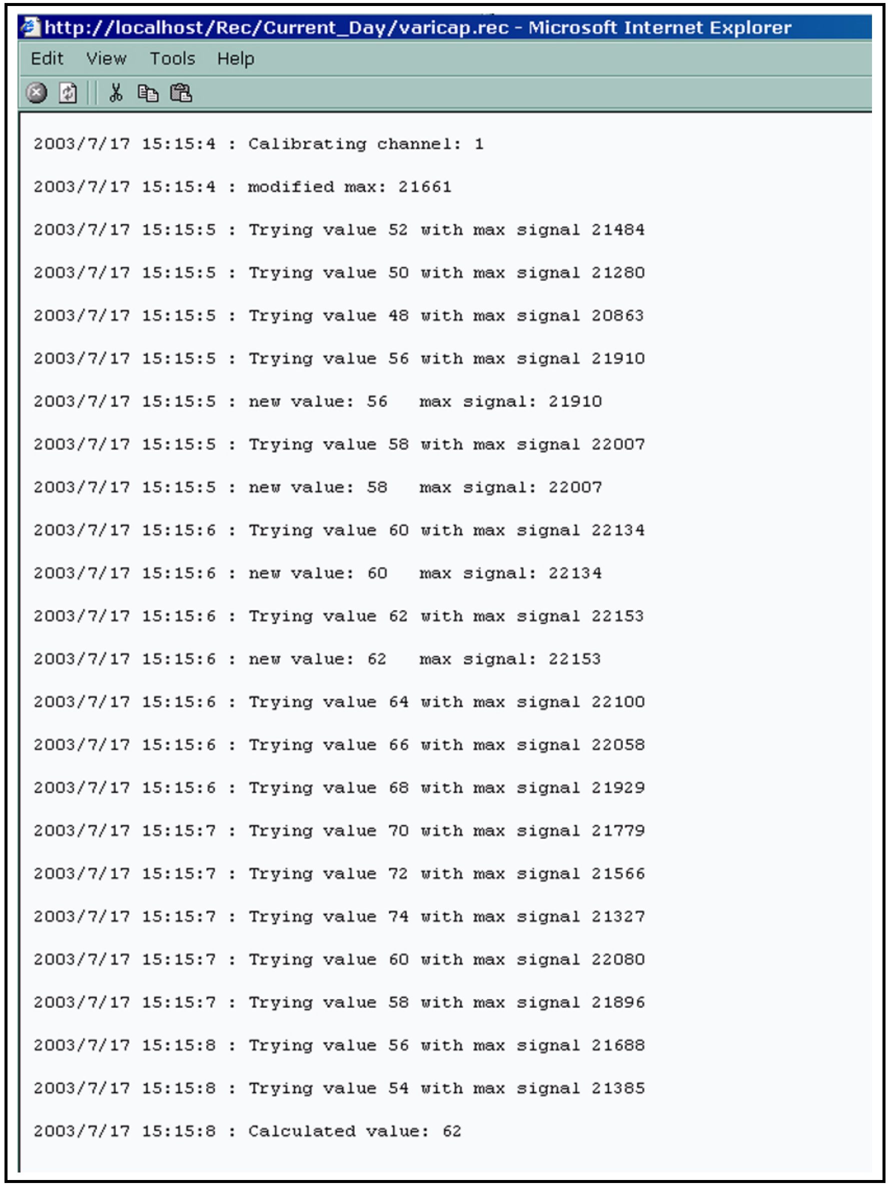
Every Coil has its own Varicap value: when you save it manually don't overwrite the other values.

Also the Varicap is automatically calculated by the system during every Scout acquisition.

The rec file is filled in by the system every time the varicap is calculated either when is done automatically or manually by the Service technicians.

If the Varicap is not correct or cannot be calculated by the system means that an error in the receiving channel occurred.

Fig. 15: Varicap.rec

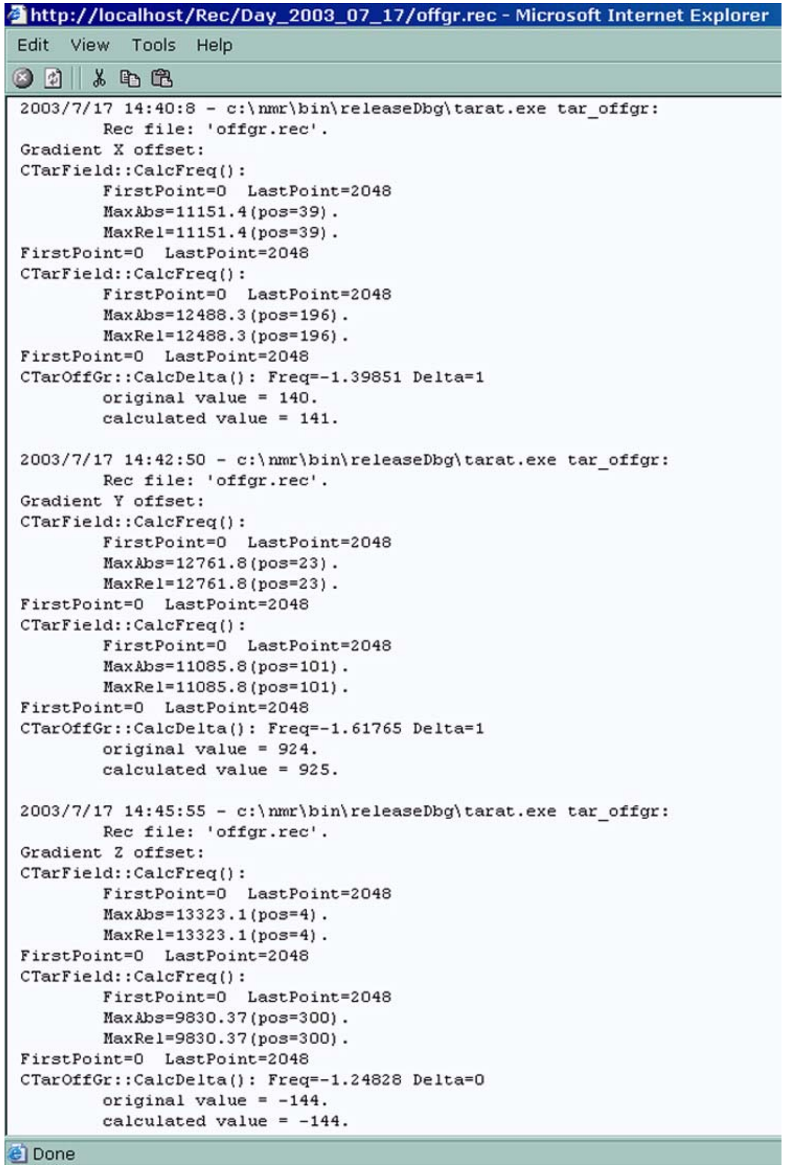

http://localhost/Rec/Current_Day/varicap.rec - Microsoft Internet Explorer
Edit
View
Tools
Help

```
2003/7/17 15:15:4 : Calibrating channel: 1

2003/7/17 15:15:4 : modified max: 21661

2003/7/17 15:15:5 : Trying value 52 with max signal 21484

2003/7/17 15:15:5 : Trying value 50 with max signal 21280

2003/7/17 15:15:5 : Trying value 48 with max signal 20863

2003/7/17 15:15:5 : Trying value 56 with max signal 21910

2003/7/17 15:15:5 : new value: 56   max signal: 21910

2003/7/17 15:15:5 : Trying value 58 with max signal 22007

2003/7/17 15:15:5 : new value: 58   max signal: 22007

2003/7/17 15:15:6 : Trying value 60 with max signal 22134

2003/7/17 15:15:6 : new value: 60   max signal: 22134

2003/7/17 15:15:6 : Trying value 62 with max signal 22153

2003/7/17 15:15:6 : new value: 62   max signal: 22153

2003/7/17 15:15:6 : Trying value 64 with max signal 22100

2003/7/17 15:15:6 : Trying value 66 with max signal 22058

2003/7/17 15:15:6 : Trying value 68 with max signal 21929

2003/7/17 15:15:7 : Trying value 70 with max signal 21779

2003/7/17 15:15:7 : Trying value 72 with max signal 21566

2003/7/17 15:15:7 : Trying value 74 with max signal 21327

2003/7/17 15:15:7 : Trying value 60 with max signal 22080

2003/7/17 15:15:7 : Trying value 58 with max signal 21896

2003/7/17 15:15:8 : Trying value 56 with max signal 21688

2003/7/17 15:15:8 : Trying value 54 with max signal 21385

2003/7/17 15:15:8 : Calculated value: 62
```

Offgr.rec

This file contains the Gradient Offset values calculated by the System during the automatic procedure.

Fig. 16: Offgr.rec



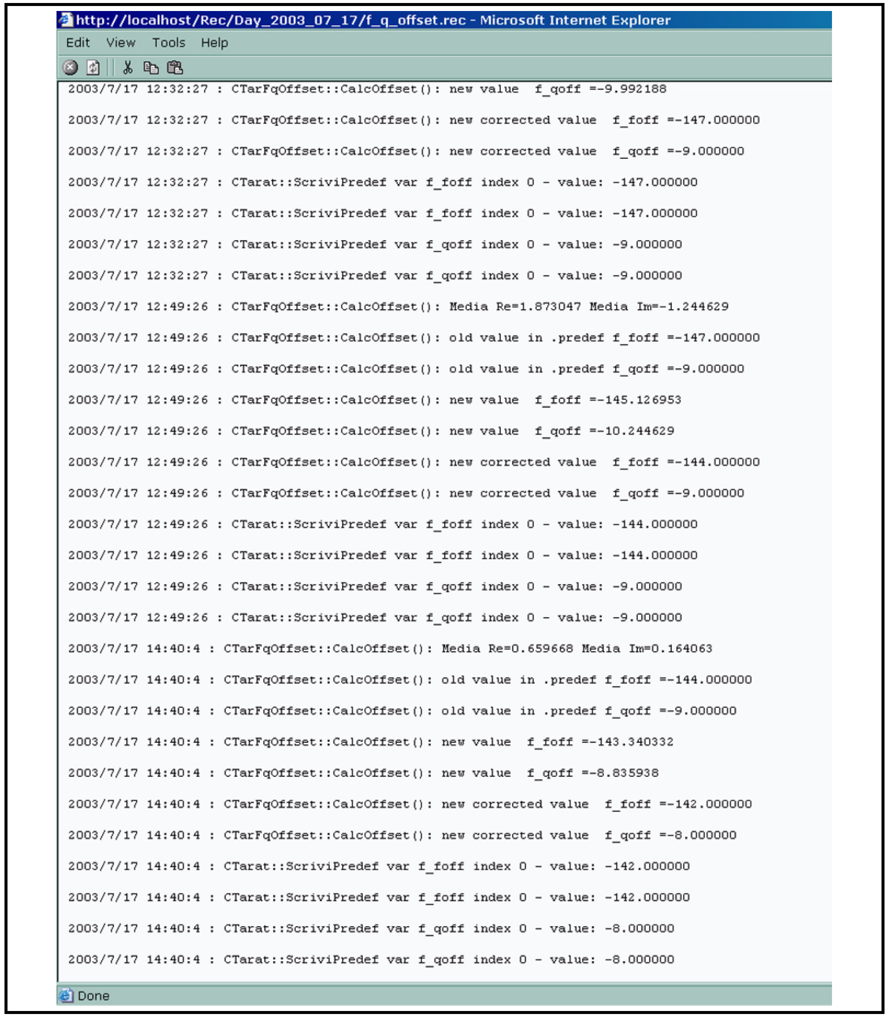
http://localhost/Rec/Day_2003_07_17/offgr.rec - Microsoft Internet Explorer
Edit View Tools Help
Done

```
2003/7/17 14:40:8 - c:\nmr\bin\releaseDbg\tarat.exe tar_offgr:
        Rec file: 'offgr.rec'.
Gradient X offset:
CTarField::CalcFreq():
        FirstPoint=0  LastPoint=2048
        MaxAbs=11151.4(pos=39).
        MaxRel=11151.4(pos=39).
FirstPoint=0  LastPoint=2048
CTarField::CalcFreq():
        FirstPoint=0  LastPoint=2048
        MaxAbs=12488.3(pos=196).
        MaxRel=12488.3(pos=196).
FirstPoint=0  LastPoint=2048
CTarOffGr::CalcDelta(): Freq=-1.39851 Delta=1
        original value = 140.
        calculated value = 141.

2003/7/17 14:42:50 - c:\nmr\bin\releaseDbg\tarat.exe tar_offgr:
        Rec file: 'offgr.rec'.
Gradient Y offset:
CTarField::CalcFreq():
        FirstPoint=0  LastPoint=2048
        MaxAbs=12761.8(pos=23).
        MaxRel=12761.8(pos=23).
FirstPoint=0  LastPoint=2048
CTarField::CalcFreq():
        FirstPoint=0  LastPoint=2048
        MaxAbs=11085.8(pos=101).
        MaxRel=11085.8(pos=101).
FirstPoint=0  LastPoint=2048
CTarOffGr::CalcDelta(): Freq=-1.61765 Delta=1
        original value = 924.
        calculated value = 925.

2003/7/17 14:45:55 - c:\nmr\bin\releaseDbg\tarat.exe tar_offgr:
        Rec file: 'offgr.rec'.
Gradient Z offset:
CTarField::CalcFreq():
        FirstPoint=0  LastPoint=2048
        MaxAbs=13323.1(pos=4).
        MaxRel=13323.1(pos=4).
FirstPoint=0  LastPoint=2048
CTarField::CalcFreq():
        FirstPoint=0  LastPoint=2048
        MaxAbs=9830.37(pos=300).
        MaxRel=9830.37(pos=300).
FirstPoint=0  LastPoint=2048
CTarOffGr::CalcDelta(): Freq=-1.24828 Delta=0
        original value = -144.
        calculated value = -144.
```

f_q_offset.rec

This file contains the Phase and Quadrature Offset values calculated by the System during the automatic procedure.

Fig. 17: f_q_offset.rec

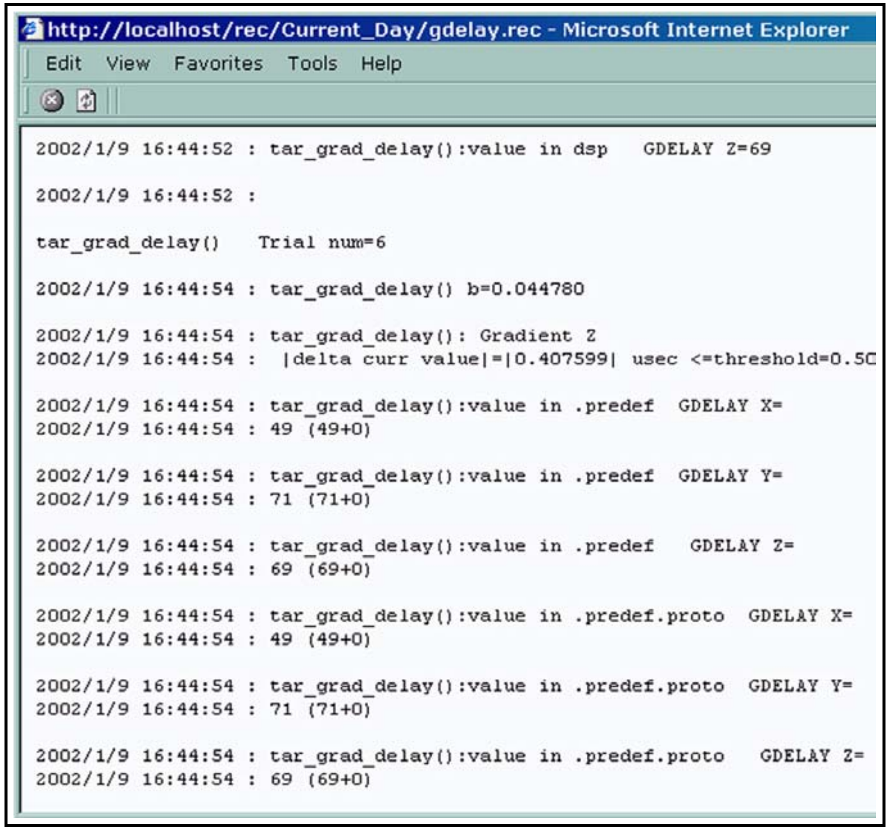

http://localhost/Rec/Day_2003_07_17/f_q_offset.rec - Microsoft Internet Explorer
Edit View Tools Help
Done

```
2003/7/17 12:32:27 : CTarFqOffset::CalcOffset(): new value  f_qoff =-9.992188

2003/7/17 12:32:27 : CTarFqOffset::CalcOffset(): new corrected value  f_foff =-147.000000

2003/7/17 12:32:27 : CTarFqOffset::CalcOffset(): new corrected value  f_qoff =-9.000000

2003/7/17 12:32:27 : CTarat::ScriviPredef var f_foff index 0 - value: -147.000000

2003/7/17 12:32:27 : CTarat::ScriviPredef var f_foff index 0 - value: -147.000000

2003/7/17 12:32:27 : CTarat::ScriviPredef var f_qoff index 0 - value: -9.000000

2003/7/17 12:32:27 : CTarat::ScriviPredef var f_qoff index 0 - value: -9.000000

2003/7/17 12:49:26 : CTarFqOffset::CalcOffset(): Media Re=1.873047 Media Im=-1.244629

2003/7/17 12:49:26 : CTarFqOffset::CalcOffset(): old value in .predef f_foff =-147.000000

2003/7/17 12:49:26 : CTarFqOffset::CalcOffset(): old value in .predef f_qoff =-9.000000

2003/7/17 12:49:26 : CTarFqOffset::CalcOffset(): new value  f_foff =-145.126953

2003/7/17 12:49:26 : CTarFqOffset::CalcOffset(): new value  f_qoff =-10.244629

2003/7/17 12:49:26 : CTarFqOffset::CalcOffset(): new corrected value  f_foff =-144.000000

2003/7/17 12:49:26 : CTarFqOffset::CalcOffset(): new corrected value  f_qoff =-9.000000

2003/7/17 12:49:26 : CTarat::ScriviPredef var f_foff index 0 - value: -144.000000

2003/7/17 12:49:26 : CTarat::ScriviPredef var f_foff index 0 - value: -144.000000

2003/7/17 12:49:26 : CTarat::ScriviPredef var f_qoff index 0 - value: -9.000000

2003/7/17 12:49:26 : CTarat::ScriviPredef var f_qoff index 0 - value: -9.000000

2003/7/17 14:40:4 : CTarFqOffset::CalcOffset(): Media Re=0.659668 Media Im=0.164063

2003/7/17 14:40:4 : CTarFqOffset::CalcOffset(): old value in .predef f_foff =-144.000000

2003/7/17 14:40:4 : CTarFqOffset::CalcOffset(): old value in .predef f_qoff =-9.000000

2003/7/17 14:40:4 : CTarFqOffset::CalcOffset(): new value  f_foff =-143.340332

2003/7/17 14:40:4 : CTarFqOffset::CalcOffset(): new value  f_qoff =-8.835938

2003/7/17 14:40:4 : CTarFqOffset::CalcOffset(): new corrected value  f_foff =-142.000000

2003/7/17 14:40:4 : CTarFqOffset::CalcOffset(): new corrected value  f_qoff =-8.000000

2003/7/17 14:40:4 : CTarat::ScriviPredef var f_foff index 0 - value: -142.000000

2003/7/17 14:40:4 : CTarat::ScriviPredef var f_foff index 0 - value: -142.000000

2003/7/17 14:40:4 : CTarat::ScriviPredef var f_qoff index 0 - value: -8.000000

2003/7/17 14:40:4 : CTarat::ScriviPredef var f_qoff index 0 - value: -8.000000
```

Gdelay.rec

This file contains the Gradient Delay values calculated by the System during the automatic procedure.

Fig. 18: gdelay.rec


http://localhost/rec/Current_Day/gdelay.rec - Microsoft Internet Explorer
Edit View Favorites Tools Help

```
2002/1/9 16:44:52 : tar_grad_delay():value in dsp   GDELAY Z=69

2002/1/9 16:44:52 :

tar_grad_delay()   Trial num=6

2002/1/9 16:44:54 : tar_grad_delay() b=0.044780

2002/1/9 16:44:54 : tar_grad_delay(): Gradient Z
2002/1/9 16:44:54 :  |delta curr value|=|0.407599| usec <=threshold=0.5C

2002/1/9 16:44:54 : tar_grad_delay():value in .predef   GDELAY X=
2002/1/9 16:44:54 : 49 (49+0)

2002/1/9 16:44:54 : tar_grad_delay():value in .predef   GDELAY Y=
2002/1/9 16:44:54 : 71 (71+0)

2002/1/9 16:44:54 : tar_grad_delay():value in .predef    GDELAY Z=
2002/1/9 16:44:54 : 69 (69+0)

2002/1/9 16:44:54 : tar_grad_delay():value in .predef.proto  GDELAY X=
2002/1/9 16:44:54 : 49 (49+0)

2002/1/9 16:44:54 : tar_grad_delay():value in .predef.proto  GDELAY Y=
2002/1/9 16:44:54 : 71 (71+0)

2002/1/9 16:44:54 : tar_grad_delay():value in .predef.proto   GDELAY Z=
2002/1/9 16:44:54 : 69 (69+0)
```

Service RecFilePlot introduction

This section deals with the monitoring and subsequent analysis of various quantities whose time evolution is interesting while evaluating:

- The characteristics of the environment in which the system must operate (with particular reference to temperature and Magnetic DC field strength)
- System adjustments while responding to changing environmental conditions (with particular reference to thermal and magnetic compensation activities)
- System parameters (with particular reference to central precession (Larmor) frequency and operating noise level).

This environment is organized in this way: analysis of the time evolution of the above mentioned quantities plays a critical role in identifying troubles relating to the presence of incorrect environmental conditions and/or damage or malfunctioning of thermal and magnetic compensation units. Moreover, the analysis performed over a long period of time can provide meaningful information (from a statistical point of view) about the relationships between failures and certain environmental conditions. In order to provide a complete tool, the monitoring procedure can be performed in three different ways, characterized by different time ranges:

- For a maximum period of a day (**<System Monitor>**: short period analysis)
- For a maximum period of one year (**<System History>**: analysis performed over a part of the lifecycle of the system)

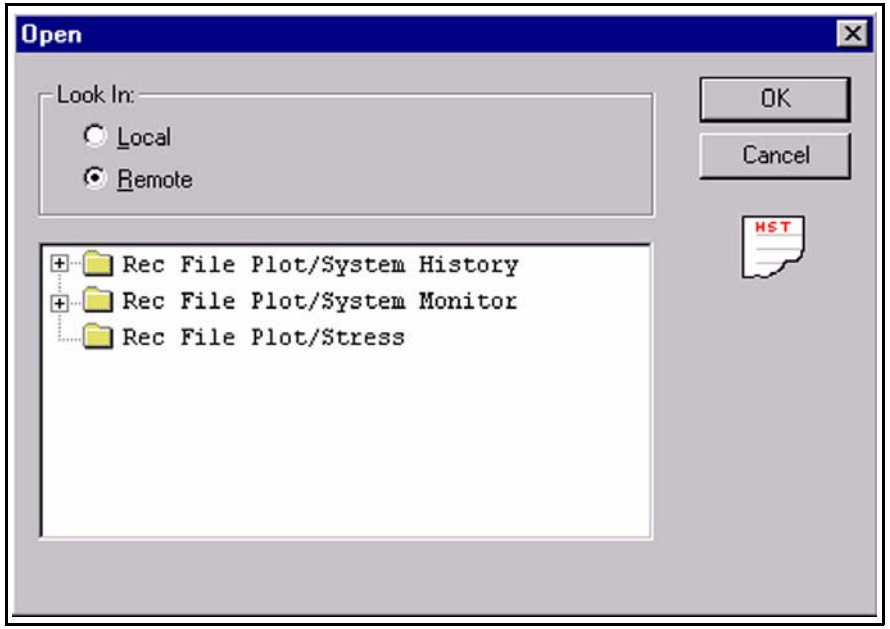
The practical tool used to inspect the quantities versus time functions resulting from the monitoring procedure is again the "*Diascope*" whose characteristics and functions are tailored for this specific application as described below.

Monitored Quantities

Three folders are available under the **<Hist>** icon of the ARAS toolbar: **<RecFilePlot/System History>**, **<RecFilePlot/System Monitor>** and **<RecFilePlot/Stress>**. They make it possible to display the data items previously collected with one of the time ranges defined above. Here is a detailed list of the monitored quantities.

NOTICE	These files are created by the system only when the corresponding test are performed (e.g.: the <System Monitor> test compiles the <RecFilePlot/System Monitor> history file)

Fig. 19: History File Selection

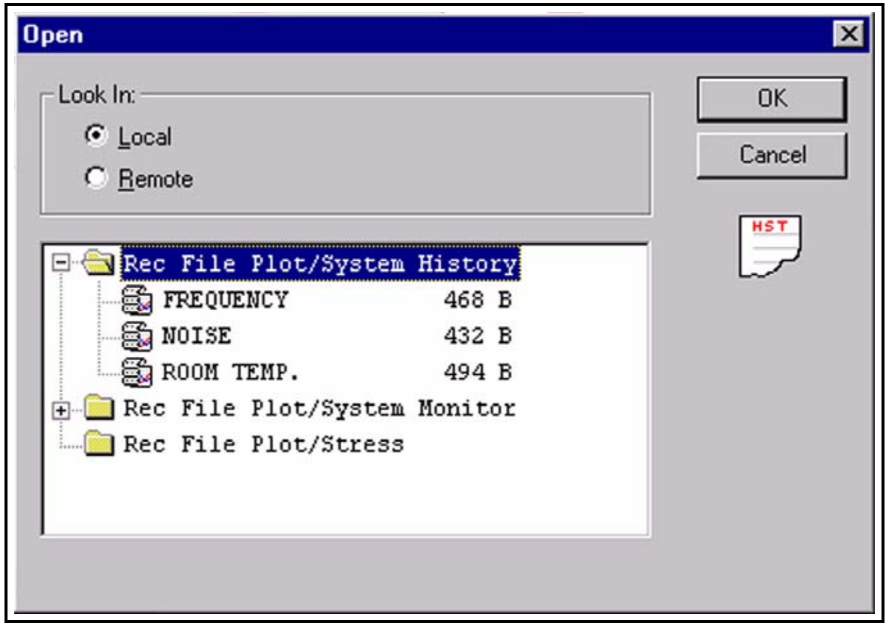


Rec File Plot/System History
Rec File Plot/System Monitor
Rec File Plot/Stress

System history

- Environment temperature
- Central precession (Larmor) frequency of static magnetic field
- Noise (average FFT)

Fig. 20: ***<RecFilePlot/System History>*** *folder*



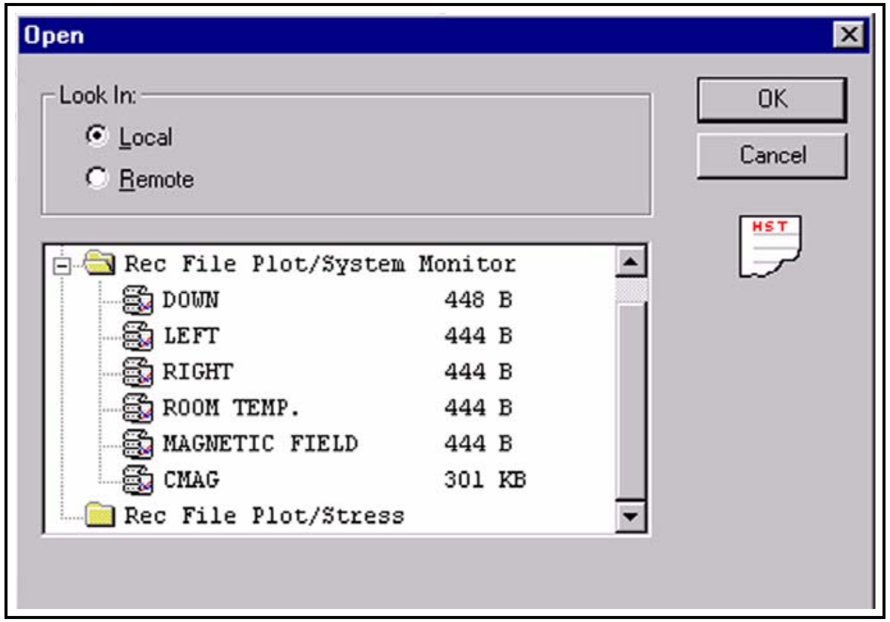
```
⊟ Rec File Plot/System History
    FREQUENCY            468 B
    NOISE                432 B
    ROOM TEMP.           494 B
⊞ Rec File Plot/System Monitor
  Rec File Plot/Stress
```

System monitor

- Temp/Power UP INNER; DOWN OUTER; DOWN INNER and UP OUTER (Temperature/power associated with each of the four heaters)
- Environment temperature
- Magnetic field strength
- Magnetic field strength/Magnetic field strength in the gantry

(The last logical channel is fundamental also as a tool while performing magnetic compensation)

Fig. 21: ***<RecFilePlot/System Monitor>*** *folder*



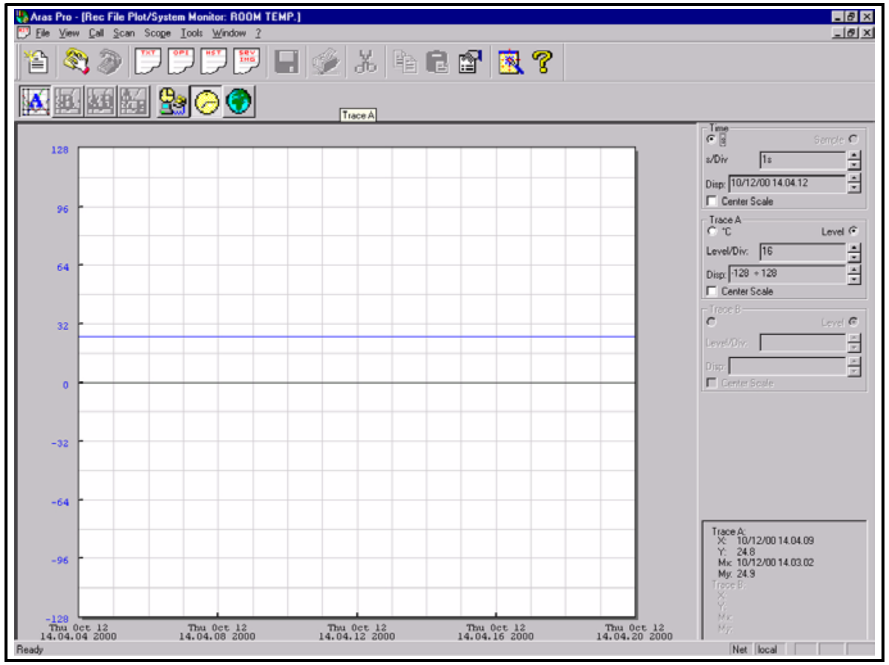
```
⊟ Rec File Plot/System Monitor
    DOWN                 448 B
    LEFT                 444 B
    RIGHT                444 B
    ROOM TEMP.           444 B
    MAGNETIC FIELD       444 B
    CMAG                 301 KB
  Rec File Plot/Stress
```

Stress

Normally used only in factory.

- Temp/Power UP INNER; DOWN OUTER; DOWN INNER and UP OUTER (Temperature/power associated with each of the four heaters)
- Environment temperature
- Central precession (Larmor) frequency of static magnetic field

Fig. 22: History file Diascope visualization



Time
● Sample ○
s/Div: 1s
Disp: 10/12/00 14.04.12
☐ Center Scale

Trace A
○ °C Level ●
Level/Div: 16
Disp: -128 ÷ 128
☐ Center Scale

Trace B
○ Level ●
Level/Div:
Disp:
☐ Center Scale

Trace A:
X: 10/12/00 14.04.09
Y: 24.8
Mx: 10/12/00 14.03.02
My: 24.9
Trace B:
X:
Y:
Mx:
My:

Like in all the other system features the scales can be set by the user to better visualize the history data.

System Check

Description

The **<System Check>** menu contains several functions allowing the operator to perform various checks of the system operation.

Operation

Perform the following operations to access the **<System Check>** environment:

- Turn on the system and wait for the operator interface to appear on the screen. If after 20 seconds no error messages are displayed (e.g.: “Non recoverable error. Scan disabled.”), this means that the computer has successfully completed its self-configuration (all modules are present) and is receiving the basic clock (for control and acquisition) from the ACM module.
- Inside ARAS select the command **<Tests>**, **<Troubleshoot.> <System check>** then press **<Exec>**

You have now entered the **<System check>** environment, from which you can test the apparatus electronics.

After approximately 10 seconds, you will hear the noise of pulsating gradients. After another 10 seconds, the screen will turn into a 2-channel oscilloscope, displaying on the left a large window displaying a pair of signals at the rate of about one pass per second, and on the right a column containing a menu of commands.

Please note that data is acquired with a 16-bit resolution in a two's complement mode and the display range of our oscilloscope (with **<Res. Div.>** =1.0 and **<Displacement>** =0) is between -32768 and +32767. Values exceeding the display range are shown with a tangent line to the upper or lower edge of the window. Displacement is relative to the visualization and not to the signal.

The message “**Incorrect scan duration”**, that is displayed when quitting, is not a warning of a malfunction, but rather indicates the time (longer than in a normal scan) that the **<System Check>** environment has been active.

Functions

You can run the following tests from the system Check environment:

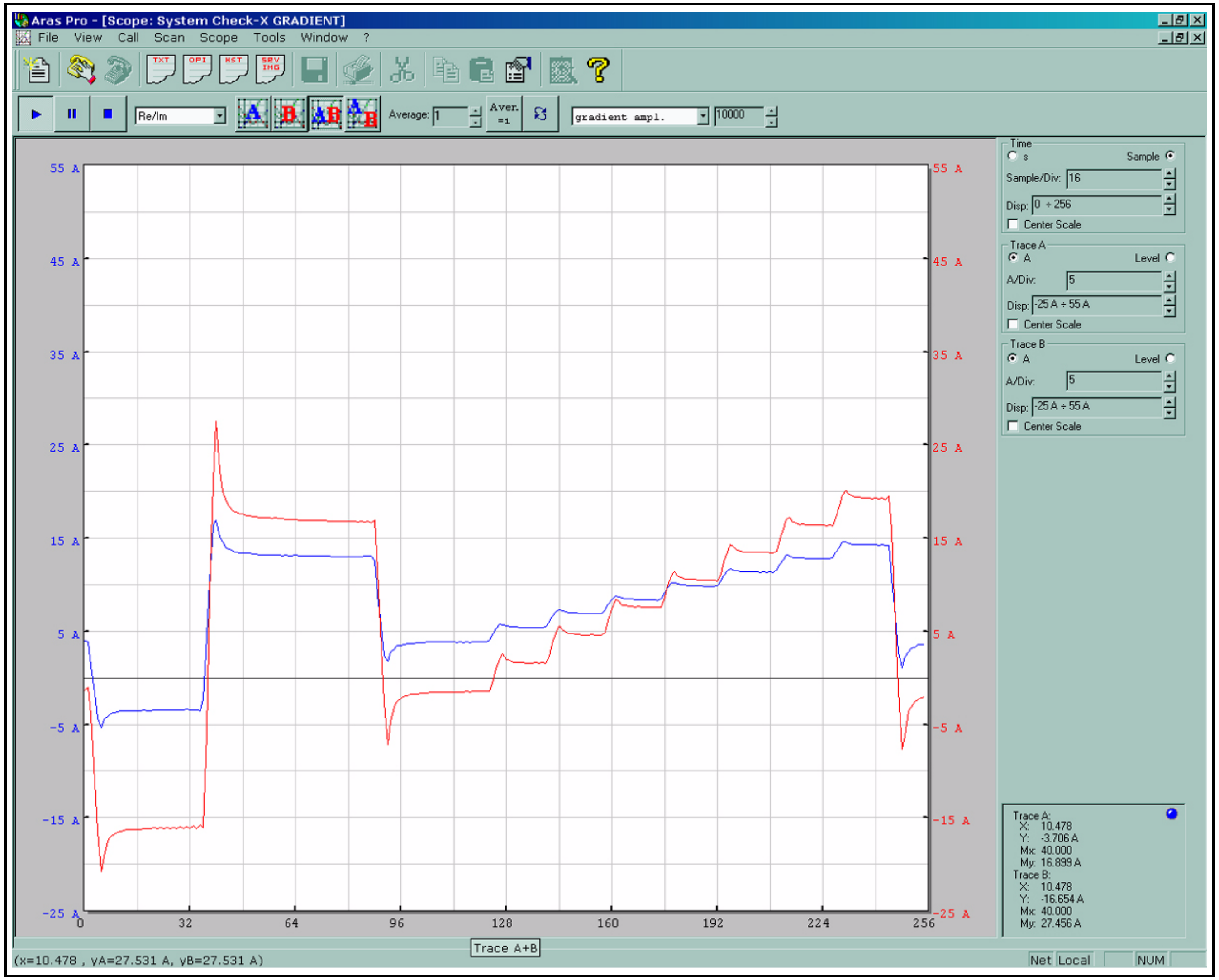
- X, Y, Z and 4th CH Gradients Coil Driving
- Transmission Chain Driving (refer to RFA check paragraph)

The control software operating on the ACM sends the digital data, which are necessary to drive the SGRA. The ACM board is in the Signal Box.

Within the ACM command, data are processed and transformed into analogue signals driving the gradient amplifier (SGRA) and sent to the same amplifier by the SGRA cable and reaches the SGRA “INPUT” connector.

Gradients are sent to the magnet side through the filter panel to the magnet connection panel (rear side). Gradient X, Y, Z and 4th CH coils are fixed into the “GANTRY” to the magnet and are made of multi layer rigid circuit matter.

Fig. 23: Channel 0, 1 and 2 are respectively X, Y and Z gradients:



Re/Im

Average: 1

gradient ampl.

10000

Time

○ s Sample ●

Sample/Div: 16

Disp: 0 ÷ 256

☐ Center Scale

Trace A

● A Level ○

A/Div: 5

Disp: -25 A ÷ 55 A

☐ Center Scale

Trace B

● A Level ○

A/Div: 5

Disp: -25 A ÷ 55 A

☐ Center Scale

Trace A:
X: 10.478
Y: -3.706 A
Mx: 40.000
My: 16.899 A
Trace B:
X: 10.478
Y: -16.654 A
Mx: 40.000
My: 27.456 A

(x=10.478 , yA=27.531 A, yB=27.531 A)

The first three channels of the System Check test are the gradient waveforms. The blue traces are the output of the ACM board and the input of the SGRA module. The red traces are the output of the SGRA module.

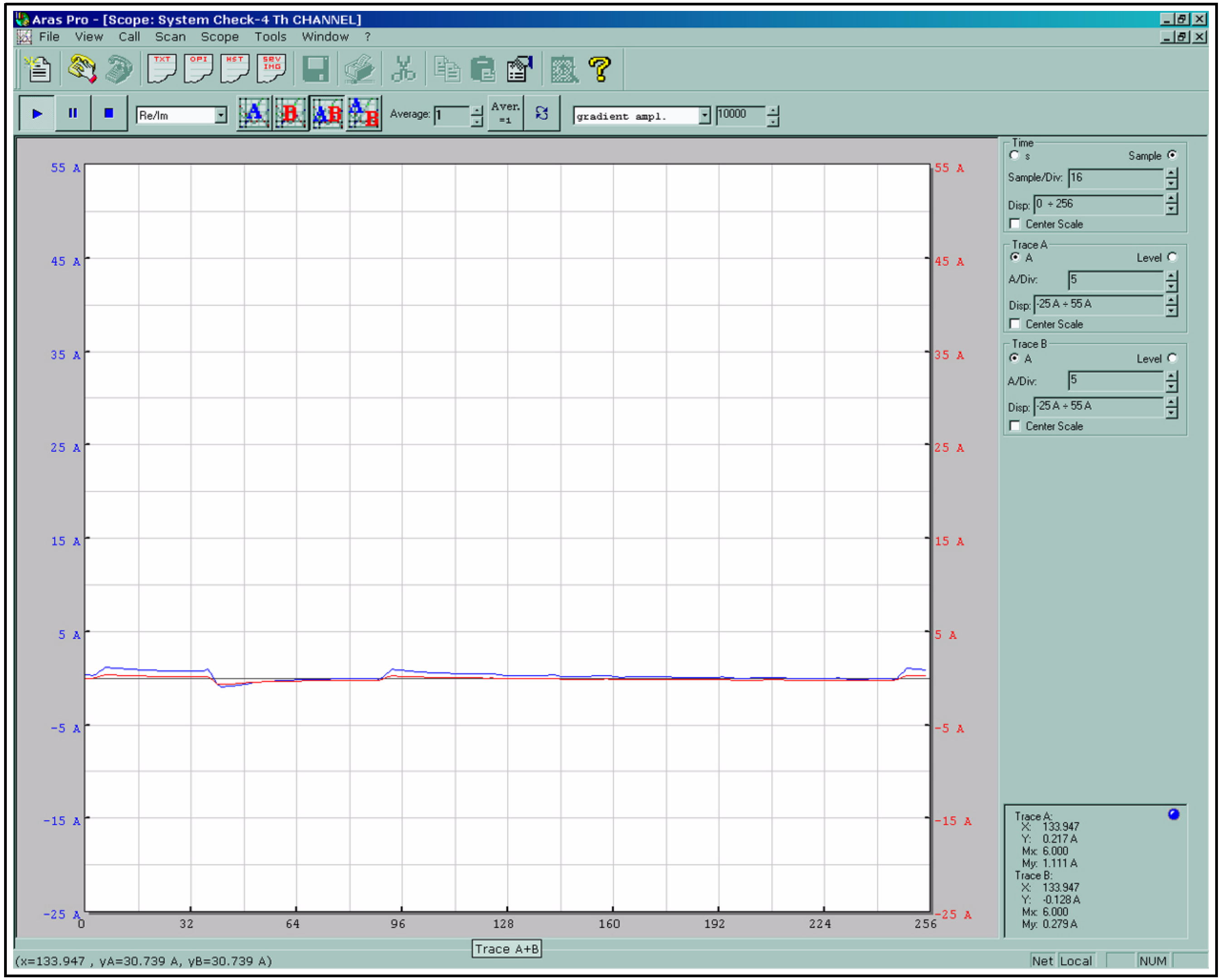
If the input traces are not present means that or the ACM is broken or the cable between the ACM and the SGRA is broken.

If all the output traces are flat probably the SGRA is broken or not powered or disabled by the MTCM module.

If only one of the output trace is flat, swap the gradient cables (e.g.: X is flat, invert X with Y) to understand if the problem is before or after the inversion.

If the problem moves to another channel means that the problem is from the SGRA on (cables or Gantry); if the problem is still on the same channel means that the gradient board is broken.

Fig. 24: IV CH Gradient waveform



Aras Pro - [Scope: System Check-4 Th CHANNEL]

Average: 1

gradient ampl.

10000

Time

○ s Sample ●

Sample/Div: 16

Disp: 0 ÷ 256

☐ Center Scale

Trace A

● A Level ○

A/Div: 5

Disp: -25 A ÷ 55 A

☐ Center Scale

Trace B

● A Level ○

A/Div: 5

Disp: -25 A ÷ 55 A

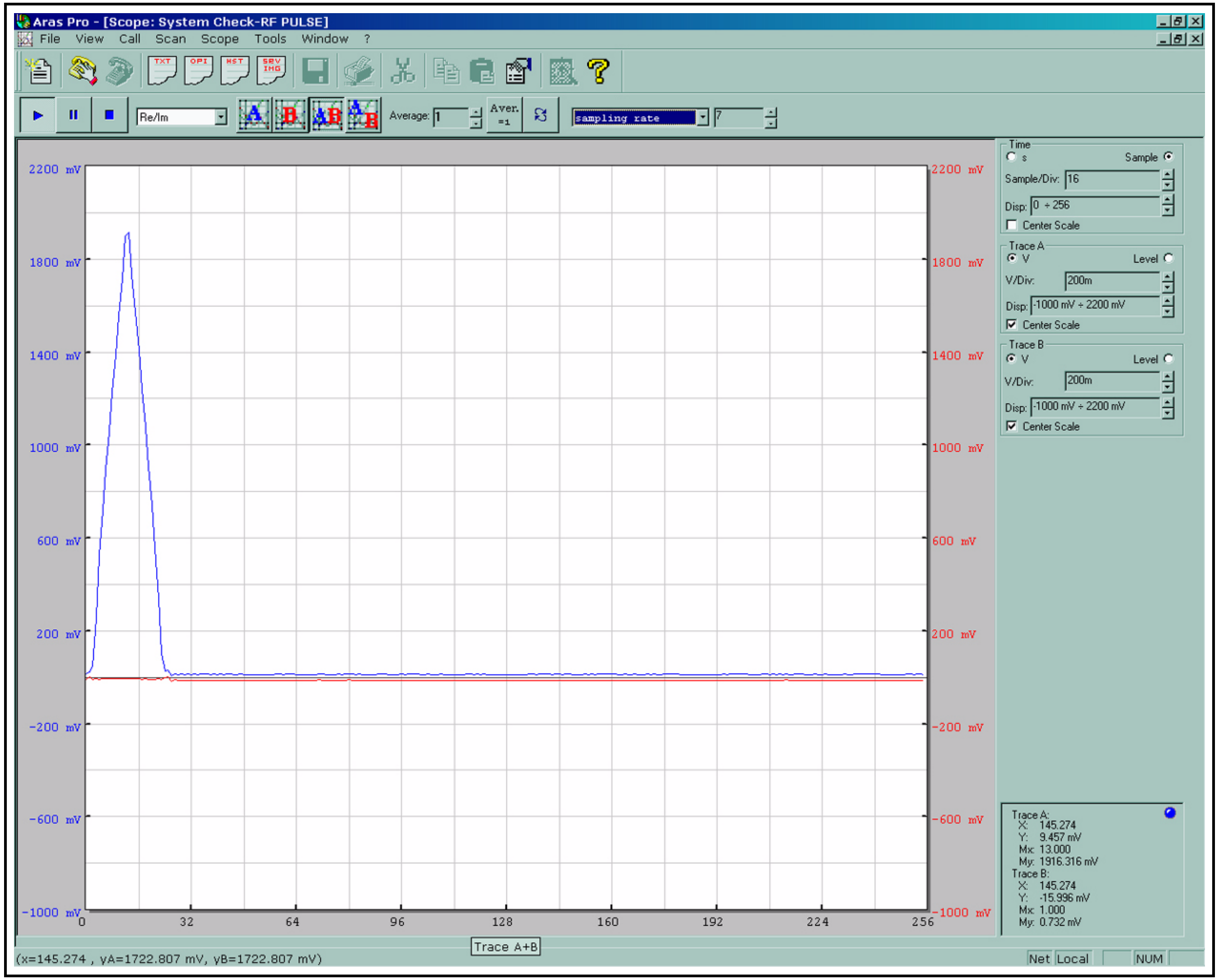
☐ Center Scale

Trace A:
X: 133.947
Y: 0.217 A
Mx: 6.000
My: 1.111 A
Trace B:
X: 133.947
Y: -0.128 A
Mx: 6.000
My: 0.279 A

(x=133.947 , yA=30.739 A, yB=30.739 A)

Analyze it using the same criteria explained for the previous Gradient waveforms.

Fig. 25: Channel 4 and 5 show the direct and reflected pulses



Time
○ s Sample ●
Sample/Div: 16
Disp: 0 ÷ 256
☐ Center Scale

Trace A
● V Level ○
V/Div: 200m
Disp: -1000 mV ÷ 2200 mV
☑ Center Scale

Trace B
● V Level ○
V/Div: 200m
Disp: -1000 mV ÷ 2200 mV
☑ Center Scale

```
Trace A:
  X:   145.274
  Y:   9.457 mV
  Mx:  13.000
  My:  1916.316 mV
Trace B:
  X:   145.274
  Y:   -15.996 mV
  Mx:  1.000
  My:  0.732 mV
```

```
(x=145.274 , yA=1722.807 mV, yB=1722.807 mV)
```

To change the spin orientation we have to send power to the phantom or patient. The SRFA takes care to amplifier the signal received from the ACM module and sent it to the Gantry (transmission circuit).

The blue trace is the direct pulse: the energy that the SRFA is transmitting to the Gantry.

The red trace is the energy that we are losing because the Gantry is not equal to the ideal load (50 Ω). It must be lower than 20% of the direct pulse.

If the red trace is flat means that the ACM module is broken or the cable between ACM and SRFA.

If the blue trace is flat disconnect the output cable and connect a dummy plug (50 Ω) to the SRFA output: if the trace is still flat means that the SRFA is broken otherwise the Gantry or the cable are broken.

Image quality

Common interference problem analysis

The most frequent cases are the presence of artifacts on the image generated by external radio frequencies, interference created by some electronic modules inside the electronic unit or “spikes”.

A typical case of the radio-frequency problem generates a strip on the image; this can be more or less thick. In both cases, the noise is selective, but when the strip is thin, this means that the noise has only a single frequency. On the other hand, if the strip is thick, it is typically a frequency modulation. Instead, the “spikes” could be classified as a large bandwidth problem that is usually generated by poor power supply or by certain motors (e.g. from elevators, air conditioning, etc.).

After performing all the system's calibrations and the relative quality tests, check that the system is operating smoothly by performing scans on patients using different sequence types (GE-FLASH, Spin-Echo, Turbo-Multi-Echo, etc.). For this type of testing, perform several acquisitions on all the four coils and assess the quality for each type of sequence.

More specifically, the images obtained must be observed in order to exclude the presence of artifacts (such as lines, light spots, bands, etc.) and magnetic fluctuations in DC mode (e.g. blurring) and in AC mode (e.g. ghosts). In order to check that the signal/noise ratio is good and that the contrast is appropriate.

Consider that some related problems (for instance lines, spots, etc.) may be caused by:

- RF external frequencies
- RF frequencies within the system due to the failure of any hardware modules

Fig. 26: Example of selective noise with a given frequency

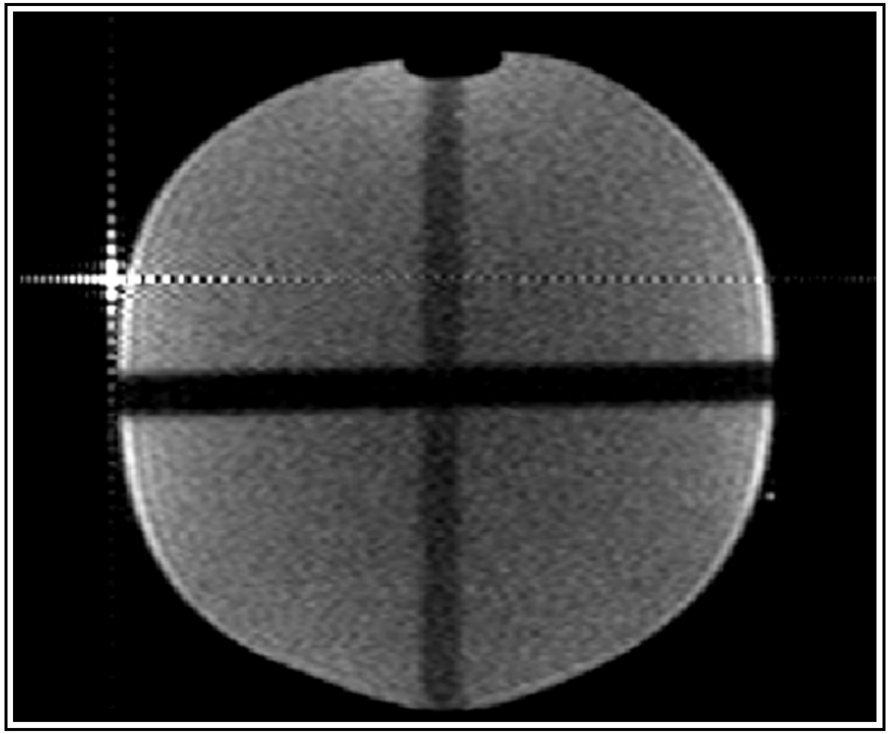


Fig. 27: Example of frequency modulation

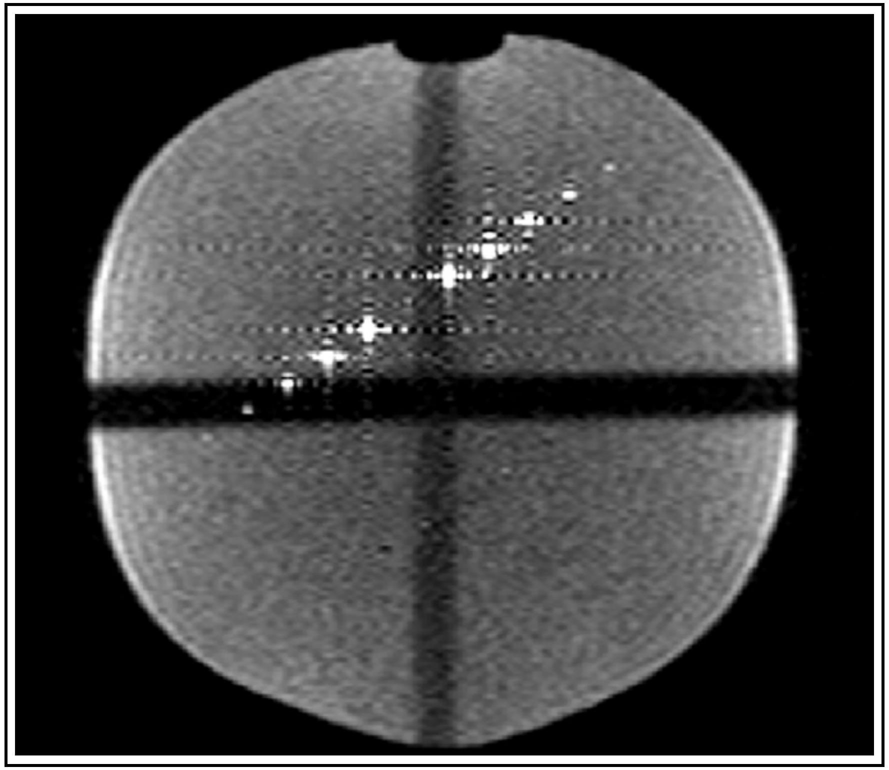


Fig. 28: Line generated by radio frequencies

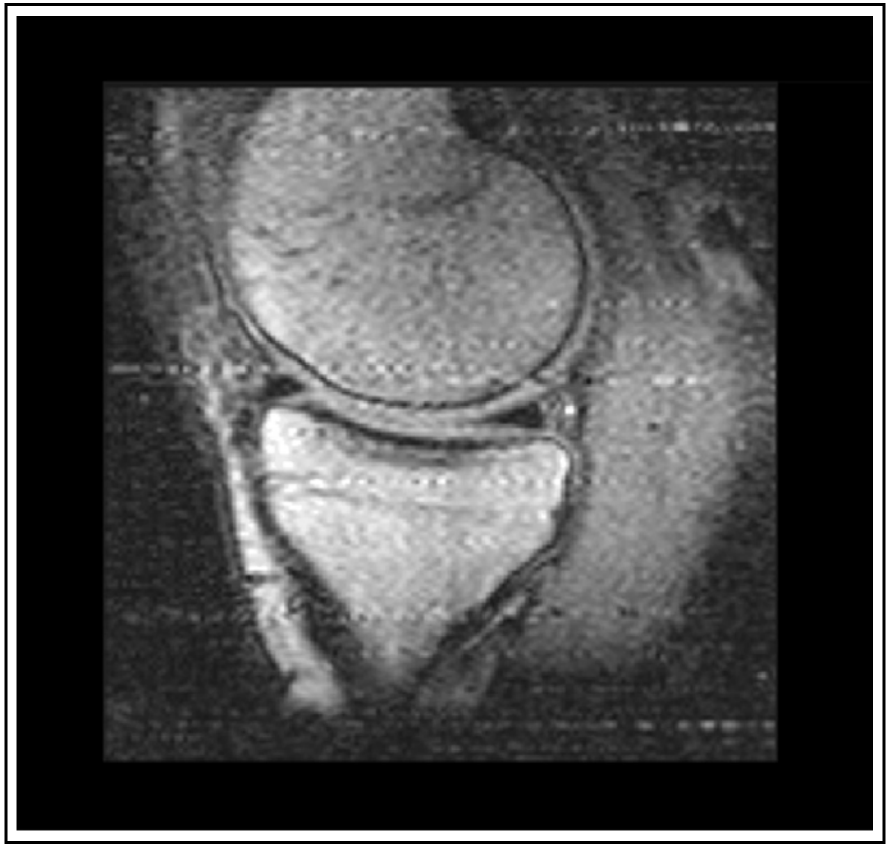


Fig. 29: Example of artifact due to the presence of "spikes"

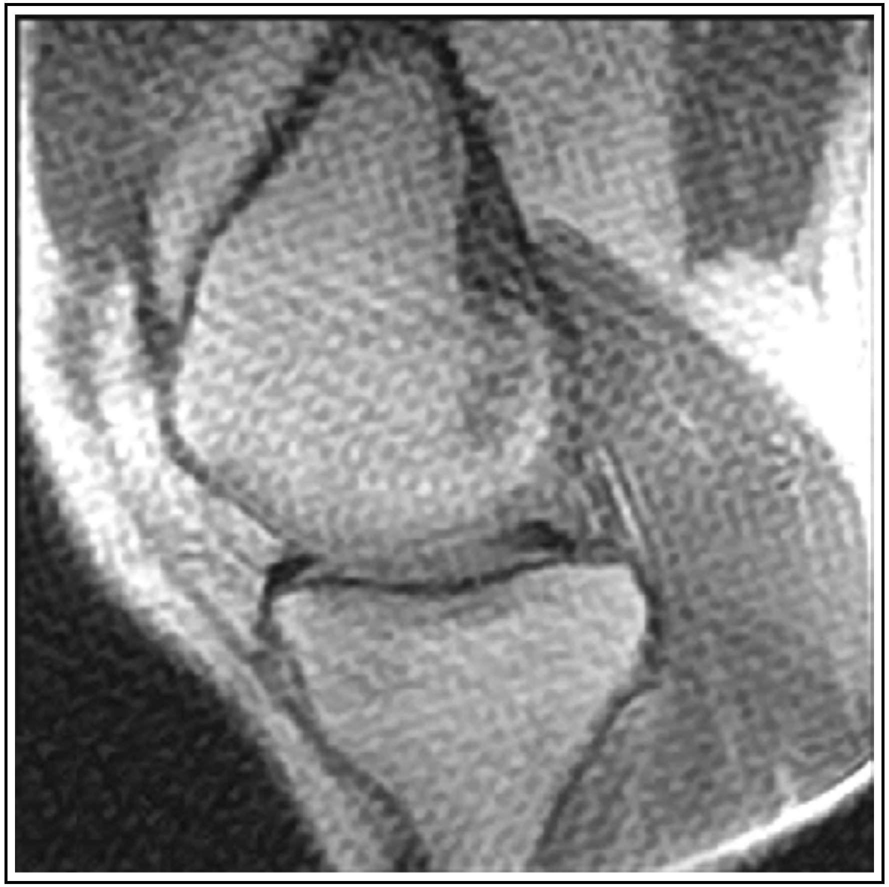
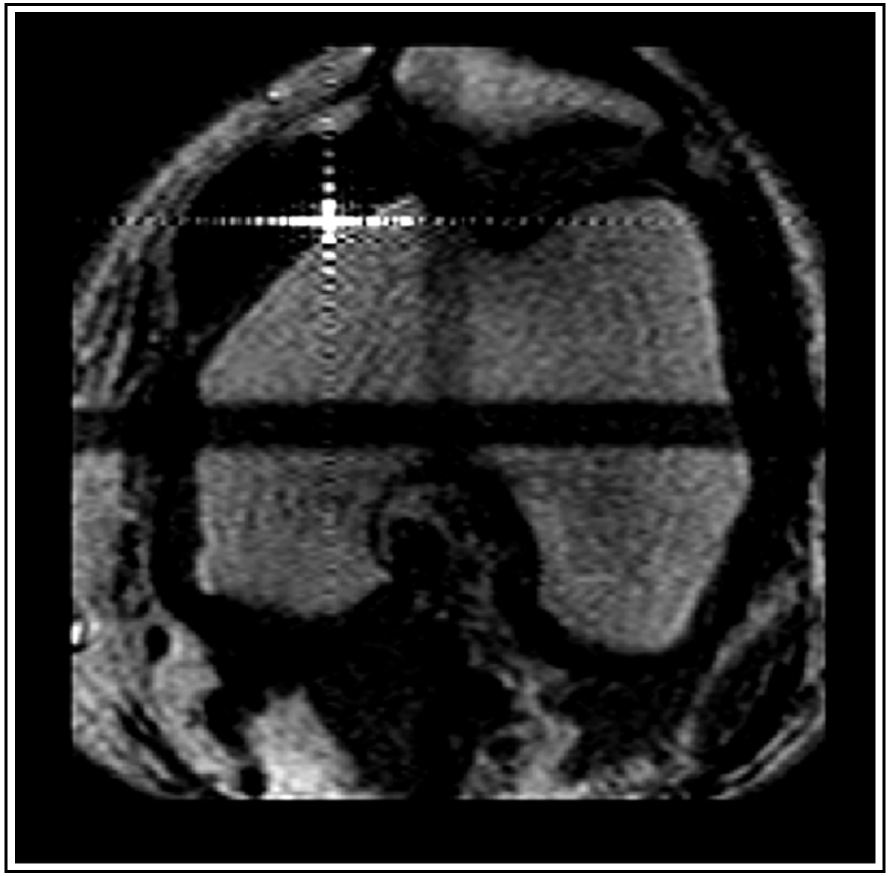


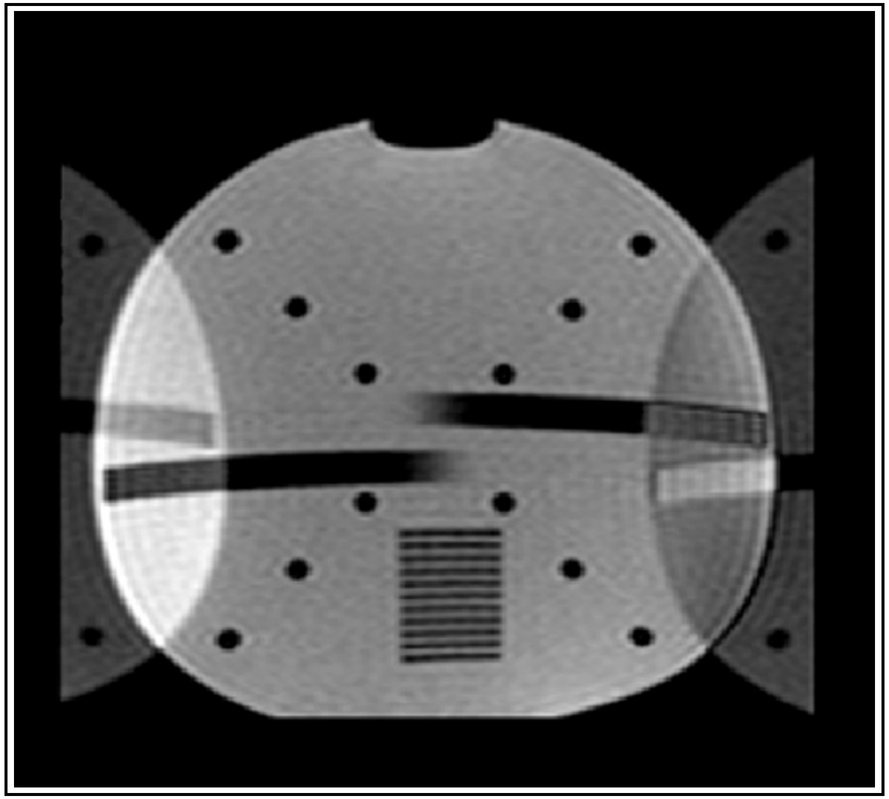
Fig. 30: Radio frequency probably due to external factors



Consider that some related problems like ghost images, may be caused by:

- Phase and quadrature offsets a long way out of the zero level
- Fluctuation of the signal due to external fields at about 50/60 Hz and 16.6 Hz

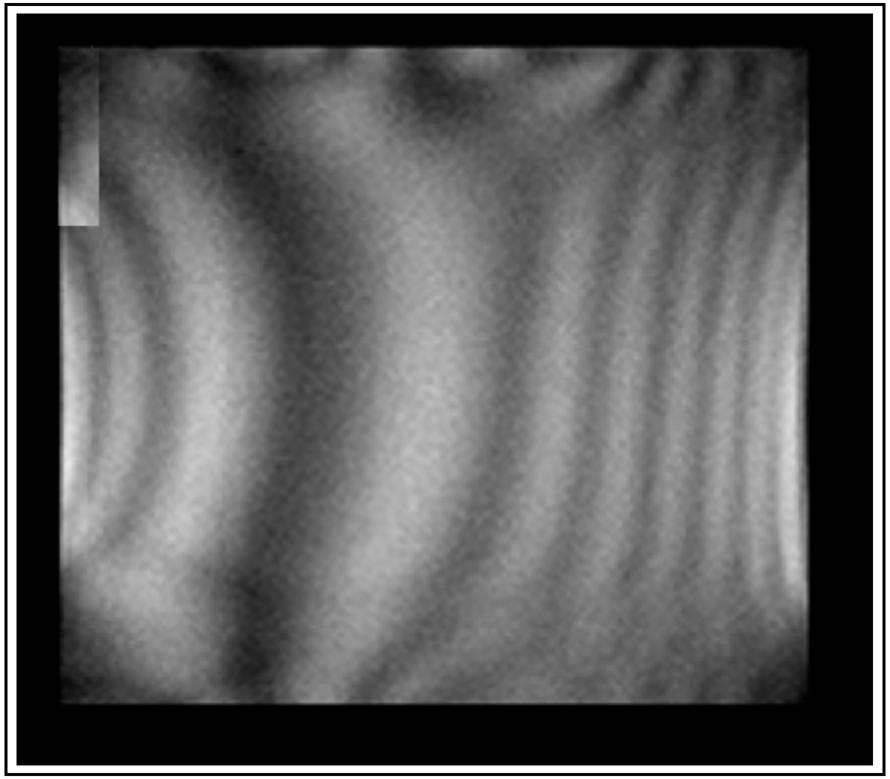
Fig. 31: Ghosts generated by external 50 Hz



Consider that some related problems, for instance, out of focus images called “blurring” effect, may be caused by:

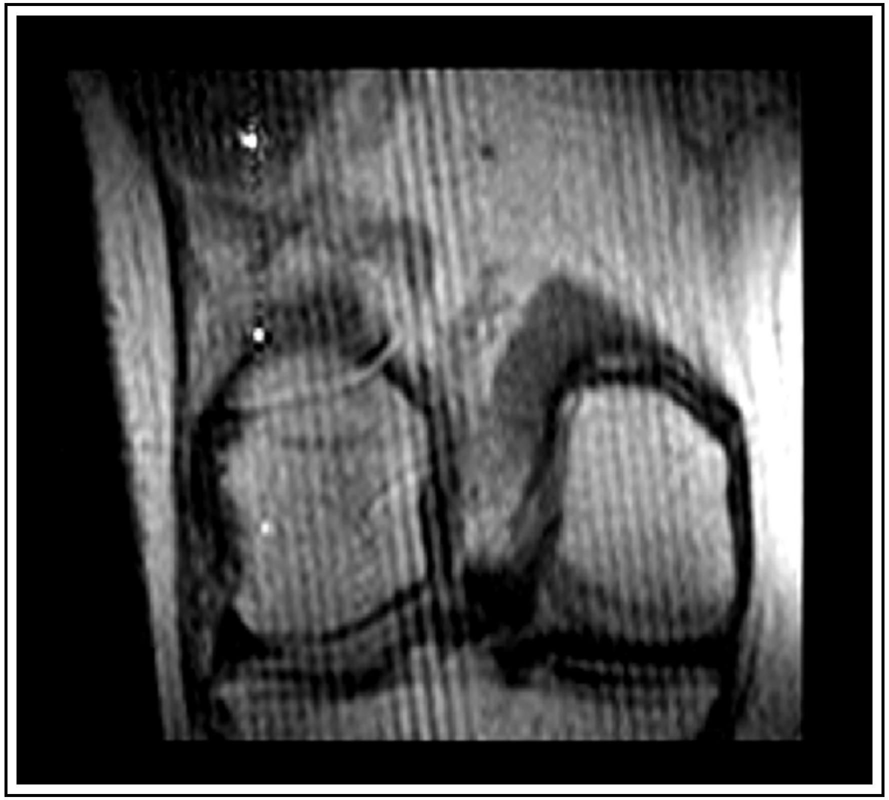
- Thermal instability of the system;
- Fluctuation of the signal due to DC magnetic interference;
- Fluctuation of the signal due to miscellaneous HW problems.

Fig. 32: "Blurring" artifact probably due to external DC (or Thermal instability)



Consider that strong spikes in the power line may cause some problems, such as the “moire” artifact.

Fig. 33: "Moire" artifact probably due to strong spikes on the power line



If the operator detects the above-mentioned artifacts in the images, he/she must first analyze them carefully.

A list of scans can be found in OPI, **<Protocol List>** under **<Standard Sequences>**. The Service operator may use them to check the image quality, hence to identify any of the above-mentioned problems.

All the current scans are to be taken in multi slice mode with the slices oriented as desired. Have at least one standard direction and one double oblique slice for each scan and change the directions between scans.

Please note that, since before each scan an automatic fine calibration of resonance frequency and of the receiving chain gain is performed, any problems should be detected through the calibration procedures and suitably signaled. It may be advisable, however, to check the results produced by calibration in the store files (**freq.rec** and **autotar.rec**).

Shielding efficiency

This section covers some problems regarding high noise levels in the system room and their possible solutions.

These kinds of problems could be generated by several things, such as: the power line cable lacking a good filtering system, network lines to transmit data between different computers, the laser camera installed close to the system or any other source not perfectly shielded. In all these cases, the normal noise level increases until it exceeds the warning noise threshold, to the detriment of the quality and resolution of the images so obtained.

This is to say that everything (line cables, personal computer, network cable, central phone line, etc.) in the room must be checked very carefully before installing the system to avoid any problems after installation.

Therefore to reduce the noise level in the room, you must ascertain in advance which are the possible causes of the problems by acquiring images in different conditions. For example, this can be done by turning off all possible sources of problems, step by step, then checking the average-fft value by clicking on the **<Shielding>** in the **<Automatic>** service menu. If the problem has not been identified yet, proceed by making sure that all power lines use a line filter, that there are no other critical instruments in the system room and that every ground cable of the machine is properly connected.

The purpose of this calibration is to check that no external noises are present in the signal picked up by he coil, such as radio-frequencies which would generate lines or light spots on the image. Moreover, the procedure checks that the noise level does not exceed a pre-set threshold value.

The program is based on running a sequence that carries out a simple acquisition of the noise picked up by the receiving coil. By submitting it to Fourier's transform, you can detect the spikes resulting from external radio frequencies and to calculate the average noise level.

With regard to these problems, we recommend putting the power line through an UPS system, so that the power line that arrives at the system or at other instruments is without noise, without selective interference or noise with a large bandwidth.

Another critical factor for the noise level is the presence of personal computers or other instruments that could create some interference by increasing the noise level. This noise could be selective interference (lines on the images) or, more likely, white noise (noisy images). However, in any case, the image quality decreases significantly.

Both the machine ground and the central ground must also be checked, because they sometimes generate problems. As a matter of fact, it has often been noted that, if the grounding problem is solved, the average-fft level decreases to a normal value (around 500).

A short list including things to be avoided during installation is given below:

- Power lines without an UPS system
- Power lines must not pass close to the system
- A layout of cables that creates a coupling between them
- Avoid putting other kinds of instruments in the same room, such as a personal computer, laser printer, mediator, etc.
- Ground cables wrongly connected
- Bad central ground

Detecting artifacts on images

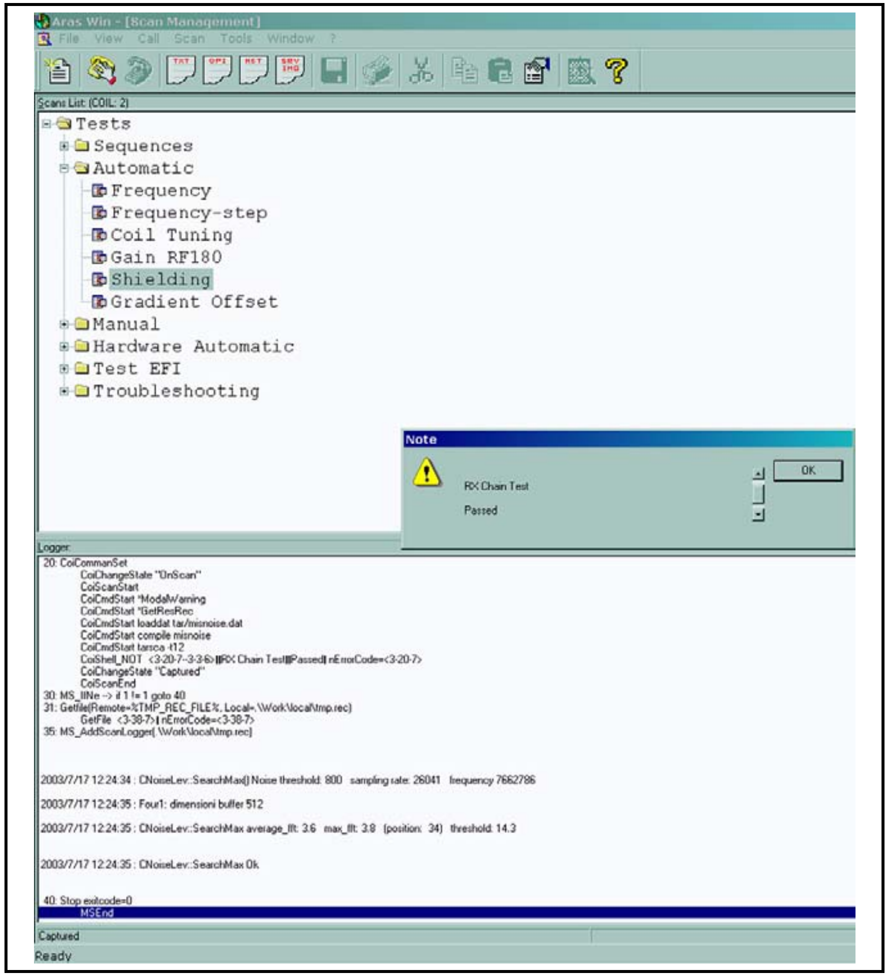
Necessary tools

- Geometrical phantom and its support

Operations

- Position the knee coil 2 with the geometrical phantom placed in axial position into the magnet
- Under ARAS select **<Automatic> <Shielding>** then **<Exec>**

Fig. 34: Automatic Shielding Test

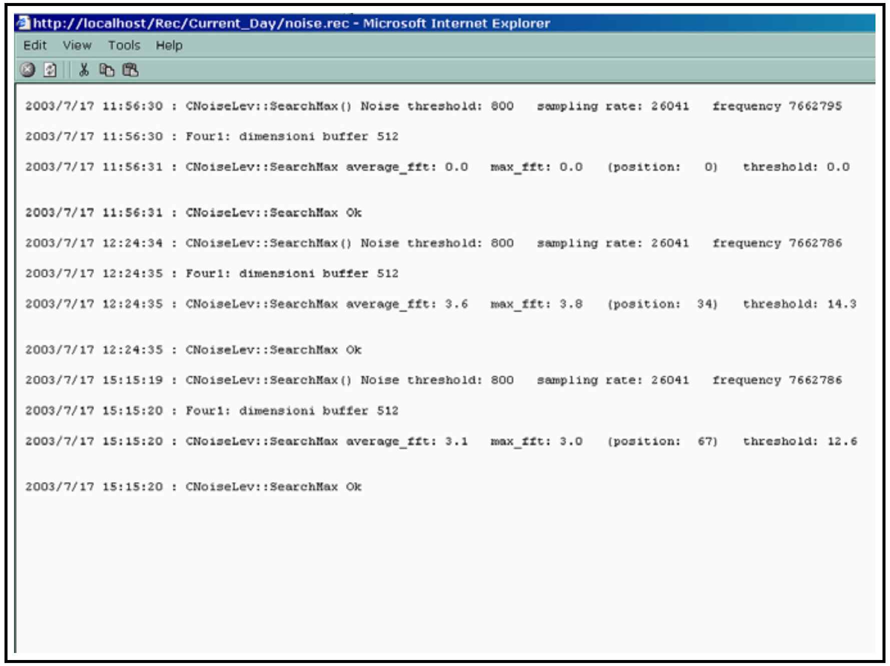


```
RX Chain Test
Passed
```

```
20: CoiCommanSet
        CoiChangeState "OnScan"
        CoiScanStart
        CoiCmdStart "ModalWarning
        CoiCmdStart "GetResRec
        CoiCmdStart loaddat tar/misnoise.dat
        CoiCmdStart compile misnoise
        CoiCmdStart tarsca -t12
        CoiShell_NOT  <3-20-7--3-3-6>||RX Chain Test||Passed| nErrorCode=<3-20-7>
        CoiChangeState "Captured"
        CoiScanEnd
30: MS_IlNe --> if 1 != 1 goto 40
31: Getfile(Remote=%TMP_REC_FILE%, Local=.\Work\local\tmp.rec)
        GetFile  <3-38-7>| nErrorCode=<3-38-7>
35: MS_AddScanLogger(.\Work\local\tmp.rec)



2003/7/17 12:24:34 : CNoiseLev::SearchMax() Noise threshold: 800   sampling rate: 26041   frequency 7662786

2003/7/17 12:24:35 : Four1: dimensioni buffer 512

2003/7/17 12:24:35 : CNoiseLev::SearchMax average_fft: 3.6   max_fft: 3.8   (position:  34)   threshold: 14.3


2003/7/17 12:24:35 : CNoiseLev::SearchMax Ok


40: Stop exitcode=0
        MSEnd
```

- Look at the message sent by the calibration procedure. If this was not successful, do not continue, but rather check the store file
- Under Internet Explorer, Rec Management page open the current folder and select “noise.rec”
- Use the scroll bar to reach the end of the file and record the average_fft value found

Fig. 35: Noise.rec File


http://localhost/Rec/Current_Day/noise.rec - Microsoft Internet Explorer
Edit View Tools Help

```
2003/7/17 11:56:30 : CNoiseLev::SearchMax() Noise threshold: 800   sampling rate: 26041   frequency 7662795

2003/7/17 11:56:30 : Four1: dimensioni buffer 512

2003/7/17 11:56:31 : CNoiseLev::SearchMax average_fft: 0.0   max_fft: 0.0   (position:   0)   threshold: 0.0


2003/7/17 11:56:31 : CNoiseLev::SearchMax Ok

2003/7/17 12:24:34 : CNoiseLev::SearchMax() Noise threshold: 800   sampling rate: 26041   frequency 7662786

2003/7/17 12:24:35 : Four1: dimensioni buffer 512

2003/7/17 12:24:35 : CNoiseLev::SearchMax average_fft: 3.6   max_fft: 3.8   (position:  34)   threshold: 14.3


2003/7/17 12:24:35 : CNoiseLev::SearchMax Ok

2003/7/17 15:15:19 : CNoiseLev::SearchMax() Noise threshold: 800   sampling rate: 26041   frequency 7662786

2003/7/17 15:15:20 : Four1: dimensioni buffer 512

2003/7/17 15:15:20 : CNoiseLev::SearchMax average_fft: 3.1   max_fft: 3.0   (position:  67)   threshold: 12.6


2003/7/17 15:15:20 : CNoiseLev::SearchMax Ok
```

In the event of noise or of signal spikes exceeding the threshold (threshold_f), the program indicates their position (co-ordinate, range 1 to 256), amplitude and frequency. Please note that a continuous signal corresponds to co-ordinate 1. This is the so-called offset that is always present. Therefore, this spike must not be considered for the purpose of evaluating the situation. In the event of persistent interference, on-site measurements must be taken exactly like those taken before installation. In addition, you must check that noise is not generated by the electronics. You must also make sure that any type of lines or spots does not damage the images. For this reason, some test scans must be taken. Conversely, if the noise level exceeds the threshold, it is likely that the receiving chain is malfunctioning or not properly calibrated. Please note that the cause of this might be white noise picked up directly by the coil. Therefore, you are advised to check that there are no possible sources near the machine and that the shielding is properly sealed.

The noise level is represented by average_fft, whose threshold value is written in the software and has been set taking into account the situation of the first machines. Please note that this calibration may also be performed from the operator's interface as a diagnostics scan. A method to understand how the noise level changes during the day is described, so it will be possible to look at noise variations in real time. Here are the operations useful for this check:

- Put the homogeneous phantom inside the knee coil
- Under ARAS, select the **<Test> <Trouble Shoot.> <RX Chain>** then **<Exec>**
- Set the **<FFT>** modality
- Set the Y-axis to 1 K. It is thus possible to visualize the noise peak better. In this modality two kinds of noise may occur
- Selective noise with a given frequency: a single peak will be displayed at that frequency; the higher the dB of the noise the higher the peak
- A large bandwidth noise (white noise): the whole level of the signal increases; this means that the noise in the room is too high
- To improve the signal display, click on the **<Average>** button and set a number around 20

When the previous operations are completed verify if the level of the signal is close to 1 K (first step) of the vertical grid, or if the “**May”** variable in the information window has a value of around 1350, that means that the noise level is good (average-fft less then 500).

On the contrary, if the level is higher, then you can also verify if the noise level when a patient puts a limb inside the coil is higher. In fact when a patient's limb is inside the coil every external disturbance is increased, because the patient acts as an antenna.

Therefore, at first you must check to see if the shielding parts are correctly applied to the patient, if the shielding cage is properly closed and shielding and if each ground cable is fixed, then check what source could create the rise in noise.

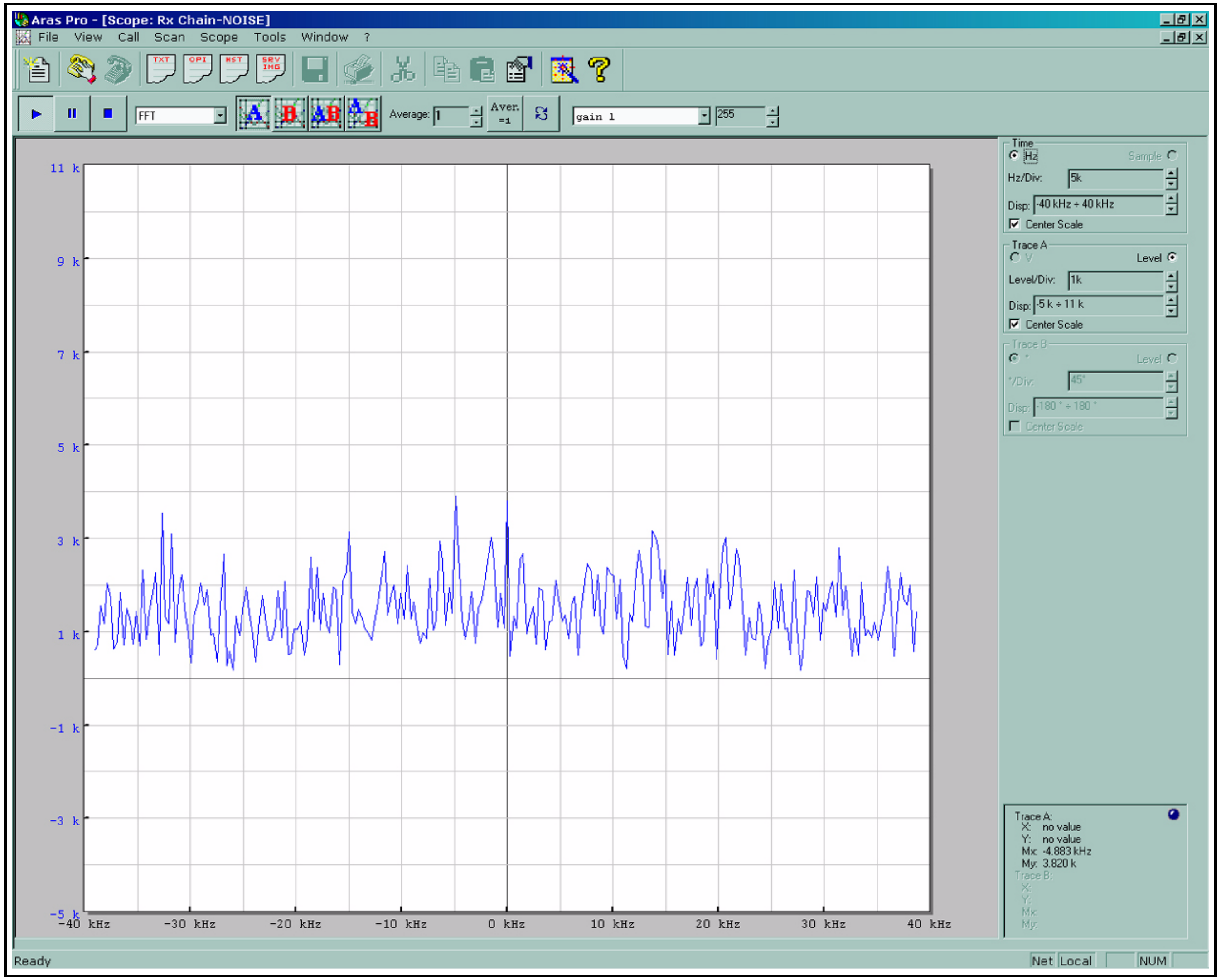
If you find something such as a personal computer, telephone or laser printer, that could be a source of noise, you will probably have to apply the solutions described previously, decreasing the noise level in the room (average-fft value around 500) until good quality images are obtained.

In the same way you can study RF interference using the **<Rx Chain>** service menu. Also in this case you can have different kinds of disturbance:

1. A well determined RF interference (one thin strip on the image)
2. A frequency modulation (example: band of strips on the image)

In the first case, set **<FFT>** mode in the **<RX Chain>** (ARAS program, **<Test>** and **<Trouble Shooting>**) environment to see a thin peak, whereas, in **<Echo>** modality a sinusoidal signal will appear. While if a frequency modulation (case 2) is present on the images, always in **<FFT>** something like a narrow rectangle, formed by a given number of peaks, will be displayed.

Fig. 36: RX Chain test, FFT visualization



Time
● Hz ○ Sample
Hz/Div: 5k
Disp: -40 kHz ÷ 40 kHz
☑ Center Scale

Trace A
○ V ● Level
Level/Div: 1k
Disp: -5 k ÷ 11 k
☑ Center Scale

Trace B
● ° ○ Level
°/Div: 45°
Disp: -180 ° ÷ 180 °
☐ Center Scale

Trace A:
X: no value
Y: no value
Mx: -4.883 kHz
My: 3.820 k
Trace B:
X:
Y:
Mx:
My:

When this window appears, select the FFT mode then the A visualization and apply these settings to all the channels (right button mouse, check the <Apply to all channel> box then click on <OK> otherwise changing the channel you'll lose you personal display settings).

Set the Frequency to 5 K to visualize a larger bandwidth (at least ±20 kHz from the central magnet frequency).

Set the Y-axis to 1 K.

If a central peak appears is the ACM oscillator and means that the Phase and Quadrature offsets are not properly calibrated to the zero level.

The meaning of this test is check if any radio frequency peaks appear close to the magnet central frequency (indicated by 0 kHz): if they appear they can generated noises on the images.

Repair

MTCM Check

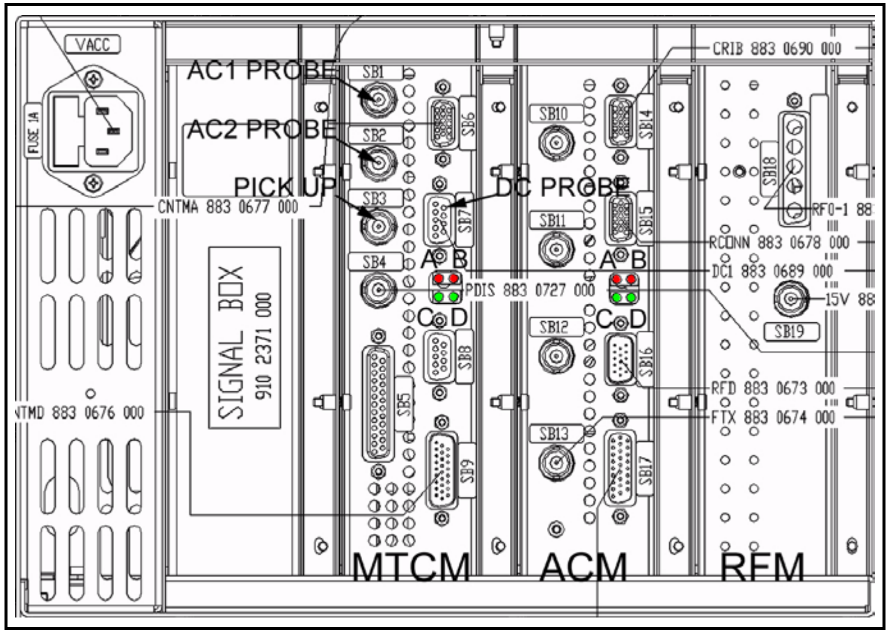
Before to proceed with the Magnetic Compensation Procedure check if the MTCM module is correctly working or not.

Open the Electronic Unit and check the MTCM led status meaning:

Tab. 4: MTCM led status meaning

Led	Normal	Error	Error Meaning
A	Off	Blinking	MTCM or DSPM broken (refer to the Led A blinking meaning table)
B	Off	Blinking	Lost communication between MTCM and TPM, lost synchronism coming from ACM or impossible perform the TPM commands
C	Blinking	Off	Refer to led B
D	On	Off	Refer to led A (if blinking the MTCM is loading data from DSPM or magnetic circuit reset)

Fig. 37: MTCM Board



Tab. 5: Led A blinking meaning table

Number of Blinking	Meaning
2	Received from ADC an unknown data
4	Received from DSPM an unknown data
6	Sensor cable connection missing
12	Wrong checksum reading thermal offsets
13	Timeout in the serial connection with DSPM
14	Wrong data from DSPM
15	Timeout reading on writing on Flash

Magnetic Compensation

Magnetic Compensation Flag Settings

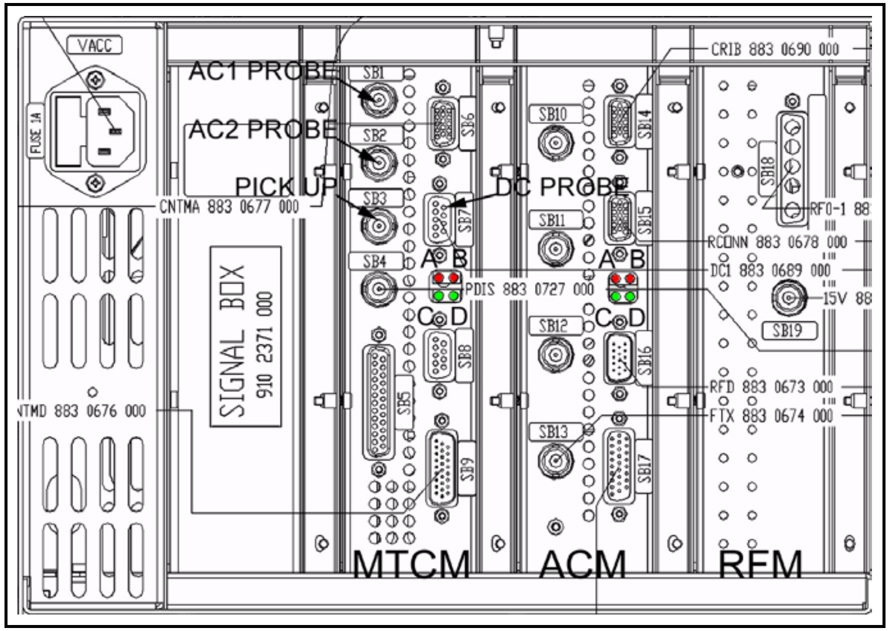
Before to start with the magnetic compensation procedure it's necessary to correctly set the MAGC flag (Internet Explorer, **<HW Configuration>** page) in according with the magnetic compensation procedure you are going to apply (refer to the next table).

Tab. 6: Compensation Flag Settings

Flag	Meaning
9500997000 – IC=0 (single probe)	Only one probe (DC probe) to measure the external DC variations and the external AC variations
9500997000 – IC=0 (multi probe)	One probe to measure the external DC variations and one (or two) probe to measure the external AC variations

The Magnetic Probes (DC and AC) must be connected to the MTCM module placed inside the Signal Box inside the Electronic Box.

Fig. 38: MTCM



For the complete procedure refer to the Magnetic Compensation chapter contained into the Installation Guide.

Magnetic Compensation Test

Ghost Test

NOTICE	The "PREZOOM" user's option must be disabled

Necessary tools

- Ghost phantom and its support: for this test, the phantom must be inserted into the down left corner hole

Fig. 39: Ghost phantom and its support

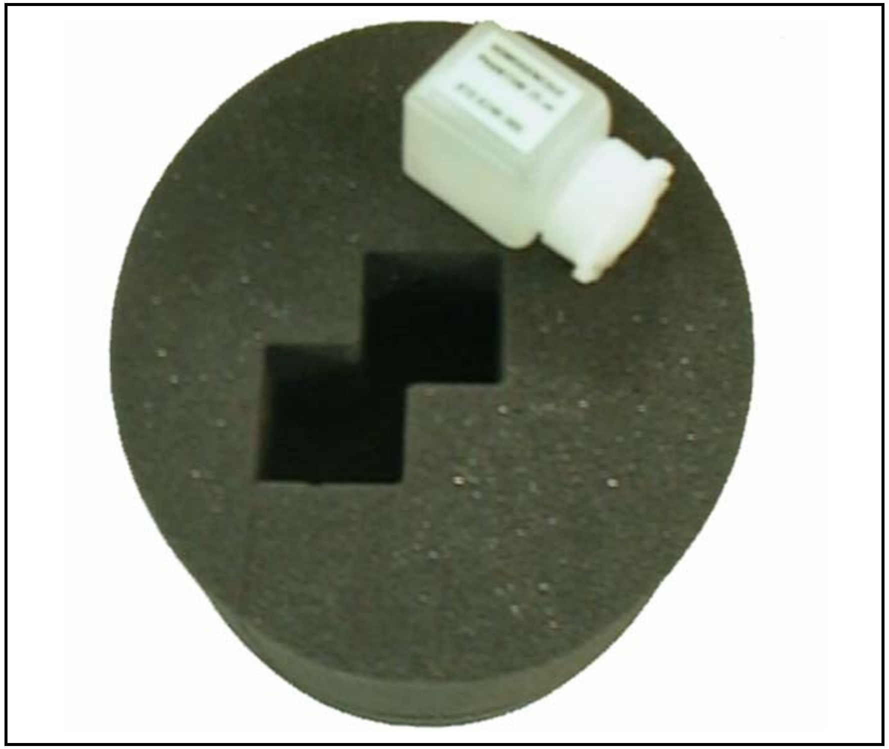
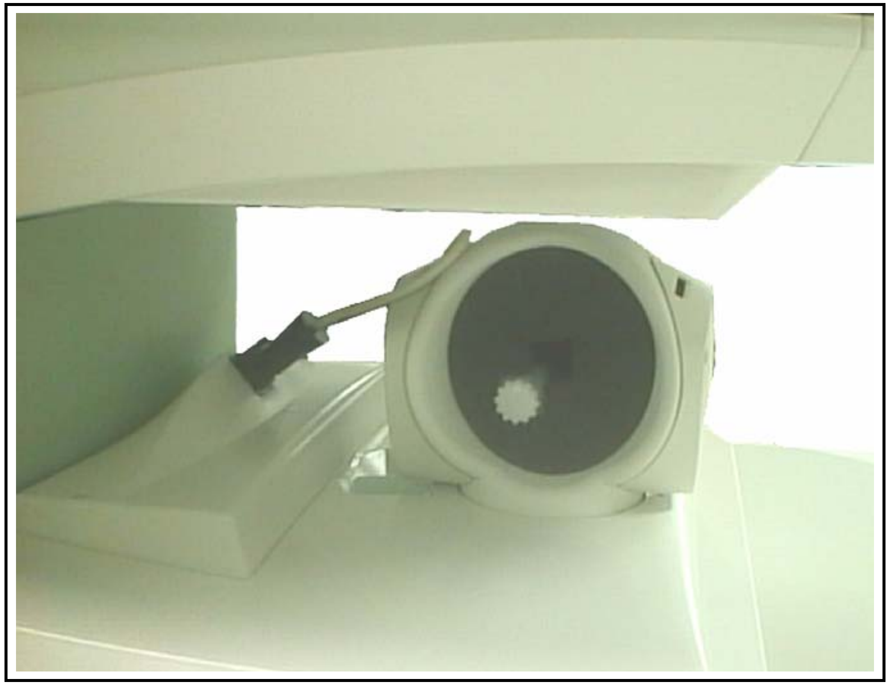


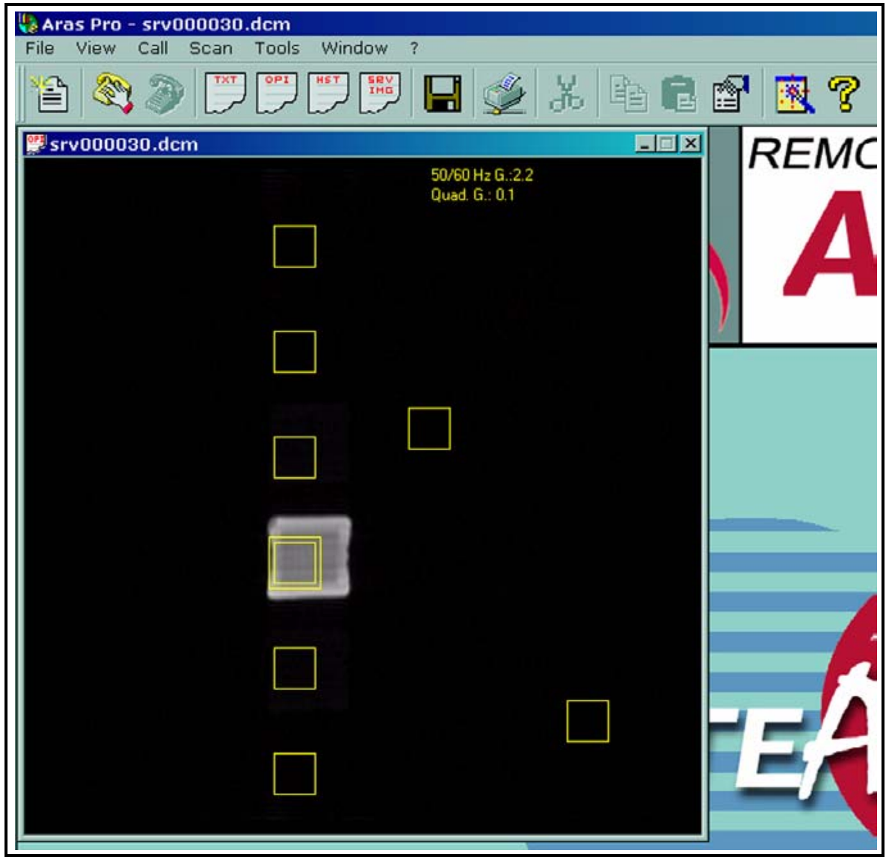
Fig. 40: Phantom and support inserted into the Knee coil



Operations

- Insert the Knee Coil 2 inside the Gantry with the small homogeneous phantom in it (like shown in the previous image)
- Under OPI Click select **<Protocol List>** then select the correct sequences following the Installation Quality Form and start them
- Wait until the images is obtained then, under ARAS, select **<SERV IMG>** icon then the correct image
- Read on the right side of the display the automatically calculated values

Fig. 41: Ghost axial measurement



```
50/60 Hz G.:2.2
Quad. G.: 0.1
```

- **Ghost** and **Quad G** must be under 2%
  - If they are correct, fill in the form
  - If **Ghost** is bigger it means that 50/60 Hz ghost is present: in this case compensate the AC magnetic external noise
  - If **Quad G** is bigger it means that Phase and Quadrature Offset are not calibrated correctly: perform these calibrations again
- Fill in the Quality Form with the obtained values

DC Ghost Test

This test is necessary to verify if DC magnetic fluctuations (<5 Hz) are present and still present after the DC compensation procedure.

Necessary tools

- Knee coil number 2
- Homogeneous phantom (axial position)

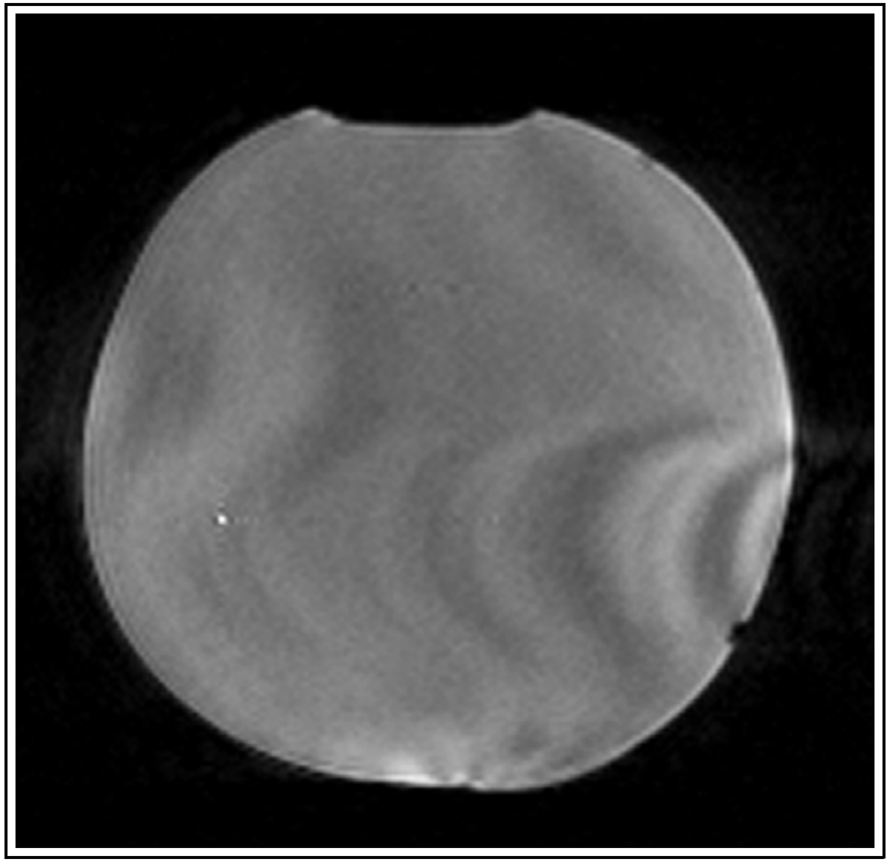
Operations

- Place the coil and insert the phantom with its support
- Under OPI Click select **<Protocol List>** then select the correct sequences following the Installation Quality Form and start them
- Wait until the images is obtained then, under ARAS, select **<SERV IMG>** icon then the correct image
- Check if DC ghost are present also changing the LUT (e.g.: see the next figure)
- If the ghost is not present fill the Installation Quality Form; if it's present check and repeat the magnetic compensation procedure
- If the ghost is still present after the magnetic compensation procedure, set to **1** the **Phase Corr** flag (Internet Explorer, **DEBUG** page). In this condition some sequences are less sensitive to external DC magnetic fluctuation

---

⚠**WARNING** **Set the Phase Corr flag to 1 only if really necessary**

Fig. 42: Image with DC ghost (blurring)



Stability test

This test is necessary to verify if AC magnetic fluctuation (16.6-20 Hz, 50-60 Hz) or DC magnetic fluctuation (<5 Hz) are present.

Necessary tools

- Geometrical phantom and its support (axial position)

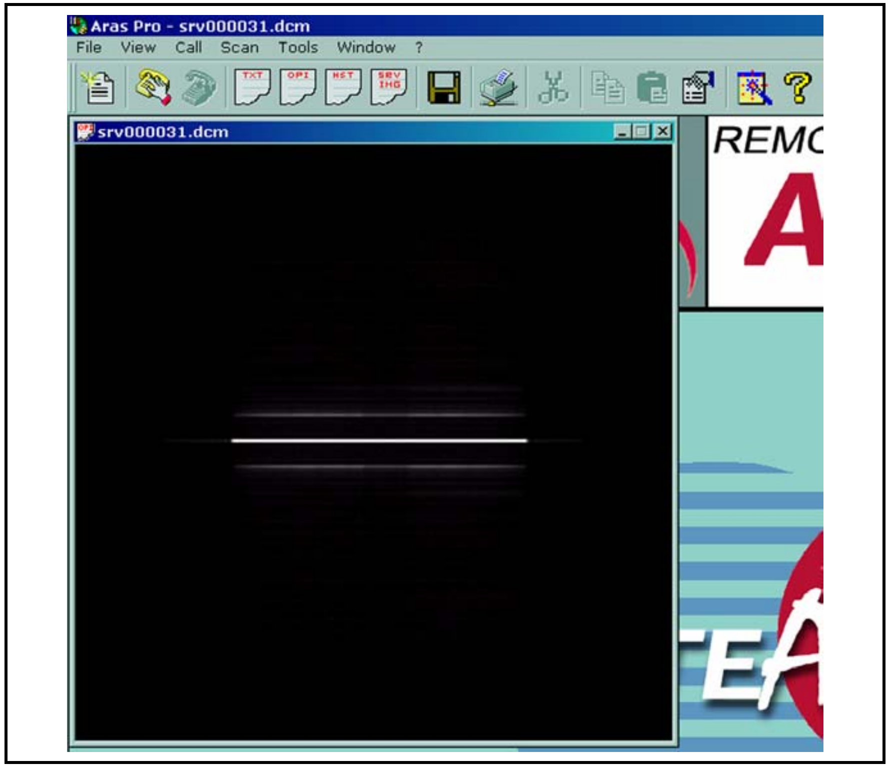
Operations

- Insert the Knee Coil 2 in Axial position with the suitable phantom in it and perform a Scout selecting the district <Other> and <A> bed patient
- Under OPI select **<Protocol List>** then select the correct sequences following the Installation Quality Form and start them
- Wait for the images to be obtained then, under ARAS, open the correct image and perform the measurement then write the value on the Installation Quality Form
- Check these values:
  – Amp. Stability lower than 3%
  – Phase Stability lower then 8°
- If the values are larger with respect to the reference values written on the quality form magnetic fluctuation is not compensated or the magnetic compensation doesn't work properly
- You can check the calculated values by reading the **stability.rec** file

⚠**WARNING** **Set the Phase Corr flag to 1 only if really necessary**

NOTICE Even if the magnetic compensation procedure was correct applied but the stability DC values are out of spec, set to **1** the **Phase Corr** flag Internet Explorer, **DEBUG** page). In this condition some sequences are less sensitive to external DC magnetic fluctuation. If enabled the Amplitude Stability values won't be applicable, if the Phase Stability is still out of spec check the image quality (refer to the DC Ghost Test)

Fig. 43: Stability test



Part 4 Software

Trouble Shooting Strategy

Software repair is a difficult task due to the complexity of today's software.

In most cases the first question that comes to mind is: “Is the problem caused by hardware or software?”

Reinstalling the software will answer this question quite reliably, but will possibly cause other problems such as loss of data (e. g. patient's images, customer protocols or system specific dynamic data that has not been saved).

To make software trouble-shooting as effective as possible some procedures to assist you in dealing with software problems are given below.

Procedure

System Backup

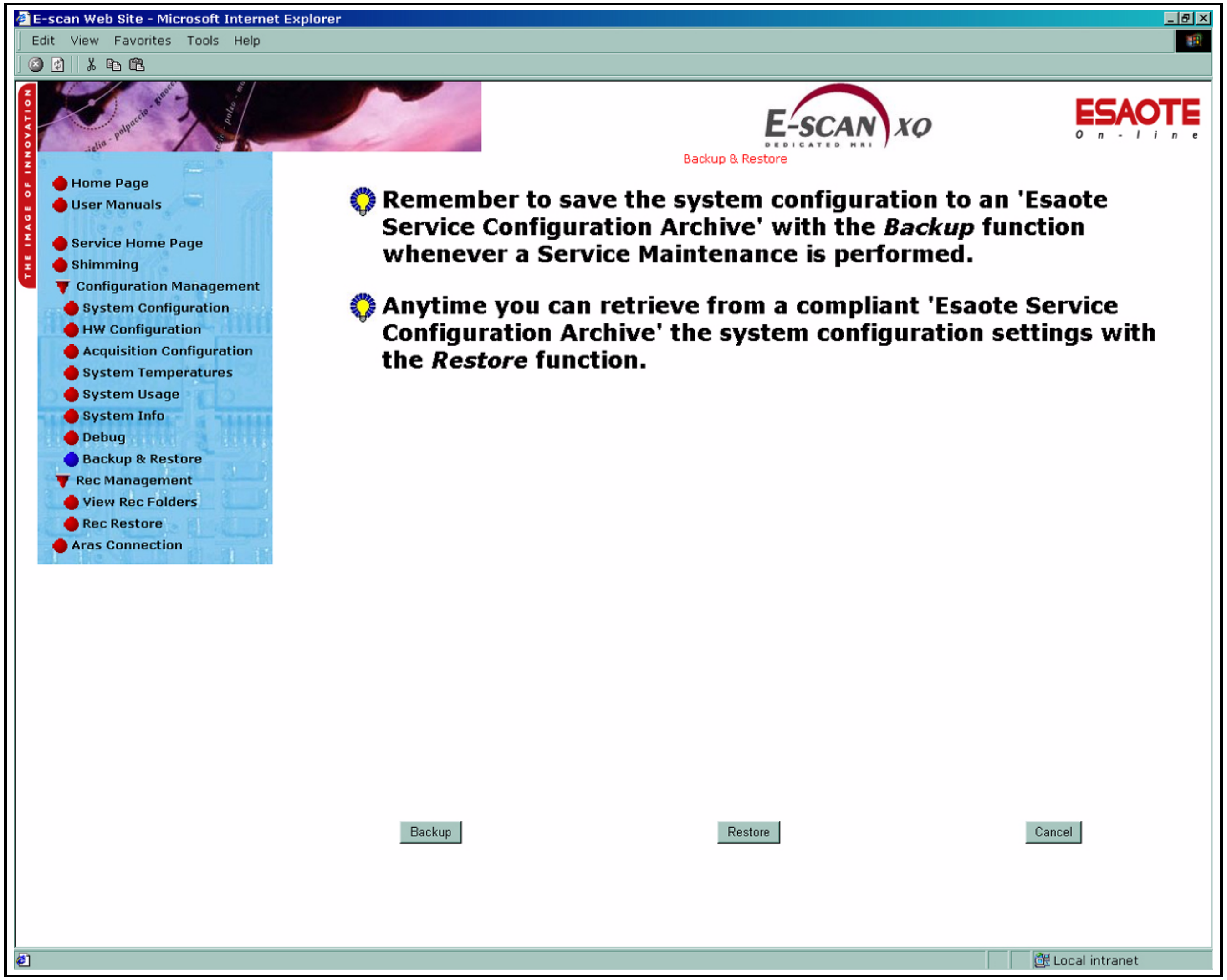
This function allows the creation of a copy of the system software with all the calibration data, but does not save the customer's images.

Perform it during every Maintenance and/or every fixing.

To create a system back up:

- Log on the system like SERV (typing the correct password) and click on the Internet Explorer icon
- Insert a optical cartridge into the ODD 3 ½
- From the homepage, select Configuration Management and Backup & Restore (like shown in the next figure)
- Follow the SW indications

Fig. 44: Configuration backup and Restore



Remember to save the system configuration to an 'Esaote Service Configuration Archive' with the *Backup* function whenever a Service Maintenance is performed.

Anytime you can retrieve from a compliant 'Esaote Service Configuration Archive' the system configuration settings with the *Restore* function.

This page allows to create the system software backup.

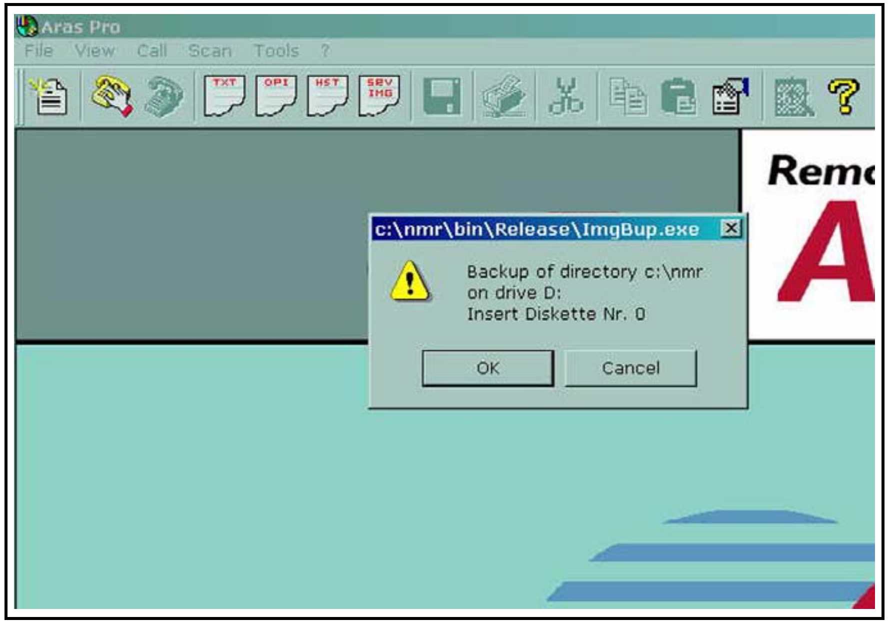
Don't create the system back up immediately after the installation but do it during the first maintenance when the system parameters are stabilized and the customer created his own protocols.

Images Back up

To create a User's images backup, act as described:

- Log the system as SERV and type the correct password
- Launch the ARAS program
- Select **TOOLS** and **Images Backup**

*Fig. 45: **Images Backup** window*



Backup of directory c:\nmr
on drive D:
Insert Diskette Nr. 0

- Insert an empty optical cartridge and store the image

Configurations restore

- Log on the system like SERV (typing the correct password) and launch Internet Explorer
- Insert the back up optical cartridge (created during the Backup procedure) into the ODD 3 ½
- From the Internet Explore homepage, select Configuration Management and Backup & Restore
- Follow the SW indications

Images Restore

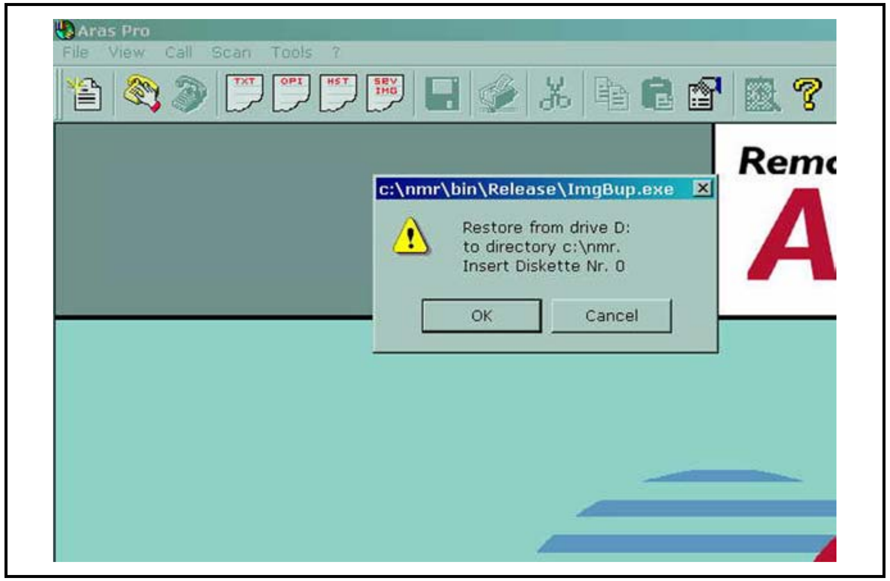
To restore the User's images from the created backup, act as described:

NOTICE	The restore procedure erase the images contained on the system Hard Disk

NOTICE	The restore procedure works only if on the system Hard Disk and on the Backup Cartridge is present the same SW Release and on the same System that created the Backup Cartridge

- Log the system as SERV and type the correct password
- Launch the ARAS program
- Select **TOOLS** and **Images Restore**

Fig. 46: *Images Backup window*



Restore from drive D:
to directory c:\nmr.
Insert Diskette Nr. 0

- Load the images from the backup cartridge

Repair

Complete Software installation

This chapter describes how to install the system software in a new system with an unformatted hard disk or in a system with a pre-installed software version.

⚠**WARNING** **Use this procedure only if the procedure contained into the Installation Guide, Software chapter doesn't work properly or in case of HD failure or in case of OPI incorrect starting!**

⚠**WARNING** **Using this procedure all the data contained into the HD will be lost during the formatting procedure of the Operating System installation!**

Operating System Installation

NOTICE Remove the network cable and connect it back at the end of the SW installation procedure!!!

- Switch on the system
- Type the **DEL** key during the BIOS boot and enter in the **BIOS SETUP** menu typing the correct password (the same as the user **SERV**)

NOTICE Ask the correct Password to your headquarter!

- Select the **BOOT** menu and set the following Boot Sequence using the + and - keys: **1. ATAPI CDROM, 2. IDE Hard Drive, 3. Removable Device, 4. Other Boot Device**
- Take the WIN2000PRO CD provided with the System and insert it into the CDROM
- Quit from the BIOS SETUP saving the new configuration and the system will re-boot automatically
- Now the System performs the boot from CD (if the sentence "**Press any key to boot from CD"** appears press **ENTER**)
- When the window "**Welcome to setup"** appears, press **ENTER** to continue
- Press **F8** to agree with the End User License
- Press **ESC** to continue with the installation without repairing the present software (if you are installing on a brand new HD this message doesn't appear)

  – Press **D** to delete the current partition

  – Press **ENTER** and then **L** to confirm the previous selection

  – Press **ENTER** to start the SW installation
- Choose the **NTSF** partition and press **ENTER**. At the end of the formatting procedure, the system copies the data on the HD and then performs some re-boots and some automatically procedures even though the System may prompt you to press enter to continue or to boot from CD-ROM. Do not interact with the System until the "**Regional Setting"** window appears (30 min)!!!
- Wait for the "**Regional Setting"** window and then check if the **English language** and **US Keyboard** are set then press **NEXT**
- In the "**Personalize your software"** window, insert the System data (e.g.: Name: E-SCAN, Organization: "leave it empty") then press **NEXT**
- In the "**WIN2000PRO setup"** window **(Your Product Key)**, insert the Product Key code copying it from the label placed on the Computer case or in the WIN2000 package then press **NEXT**

- In the “**WIN2000PRO setup”** window **(Computer Name And Administrator Password)**, insert the **Computer Name** (e.g.: E-SCAN) but leave empty the **Administrator Password** field then press **NEXT**
- In the “**Date and Time Setting”** window check and in case insert the correct date and time and the automatic time change then press **NEXT**
- In the “**Completing the WIN2000 Setup Wizard”** remove the WIN2000 CD-ROM and press **NEXT** to perform an automatic re-boot
- After several minutes, in the “**Welcome to the Network Identification Wizard”** window press **NEXT**
- In the second “**Users of This Computer”** window, select “**User must enter a user name…”** then press **NEXT**
- In the “**Completing the Network Identification Wizard”** window press **FINISH**
- Perform the log-on like **Administrator** user (NO PASSWORD NEEDED)
- Uncheck the box “**Show this window at startup”** and press **EXIT** to close the “**Windows welcome”** window

NOTICE	Perform the following setting without re-booting the system. Re-boot at the end of them when the procedure says to Re-boot!!!

- From the desktop, select **<START> <SETTINGS> <CONTROL PANEL>** and the **<CONTROL PANEL>** icon
- From the “**Control Panel”** window select the **<ADMINISTRATIVE TOOLS>** icon then in the opened window select **<Local Security Policy> <Local Policies> <User Right Assignments> <Change The System Time> <Add>** then choose **<User>** (at the end of the list). Now select **<Add> <Ok>** then close it with the button **<X>**
- Insert the WIN2000 CD-ROM and close the outplay window
- From the “**Control Panel”** window, select the **<Add/Remove Programs>** icon then **Add/Remove window components** and wait for the System refresh, then check the **Internet Information Services** box, then scroll down and uncheck the **Outlook Express** box then press **NEXT**, wait for the end of the installation procedure then press **FINISH** and **CLOSE**
- From the **<Control Panel>** window, select the **<Automatic Updates>** icon, and in the opened window uncheck **the Keep my computer up to date…** box. Press **Apply** and **OK** to save the changes
- Remove the WIN2000 CD-ROM from the CD-ROM
- From the **<Control Panel>** window, select the **<System> <Hardware> <Device Manager>** and verify that all the System peripherals are present and correctly installed. If a “**?”** or “**!”** sign is present means that peripherals is not correctly installed, in this case double click on it and then select “**Update Drivers”** (or “**Reinstall drivers”**) and follow this procedure:
  - – In the “**Welcome to the Upgrade Device Drivers”** window press **NEXT**
  - – In the “**Install Hardware Device Drivers”** window select “**Search for a suitable driver for my device (recommended)”** and press **NEXT**
  - – In the “**Local Driver Files”** window select “**Specify a Location”** and deselect all the other choices then insert the ESAOTE CD-ROM containing the SW Release you are going to install before to press **NEXT**
  - – In the “**Upgrade Device Driver Wizard”** window write in the “**Copy Manufacture's file from”** field the path where the correct driver is in according with the device you are installing (see the next list):
    - ⇨**MULTIMEDIA AUDIO CONTROLLER** (Audio card): **$:\Drivers\System\Asus P4PE (SMWDMCH4)**
    - ⇨**UNIVERSAL SERIAL BUS** (Mother board USB Ports): **$:\Drivers\System\Asus P4PE (USB2)**

- ⇨ETHERNET CONTROLLER (LAN card): **$:\Drivers\Lan\Broadcom 440x**
- ⇨**PCI SIMPLE COMMUNICATIONS CONTROLLER** (Modem) **$:\Drivers\Modem\US Robotics V92VOICE WIN INT\WIN2K_XP**
- ⇨**Other PCI bridge device** (ESAOTE DSPM card): **$:\Drivers\DSPM**
- ⇨**VIDEO CONTROLLER** (AGP Video Card): **$:\Drivers\Vga\Ati Radeon 7500**

– In the "**Completing the Upgrade Device Driver Wizard"** press **FINISH**

– Close the opened windows saving the changes

NOTICE	$ is the CD-ROM driver unit letter assigned by the WIN2000 operating system

NOTICE	If the "**Digital Signature Not Found**" window appears answer **YES**

- Re-boot the System and perform the log-on like **Administrator** user (NO PASSWORD NEEDED)
- Uncheck the box "**Show window at startup"** and press **X** to close the "**Desktop Help"** window (and in the next re-boot also uncheck the box "**Show this next time you start Window"** and press **X** to close the **"Desktop Help"** window)
- From the desktop, select **<START> <SETTINGS> <CONTROL PANEL>** and the **<DISPLAY>** icon. In the **Display** window select **<SETTINGS>**. Inside the **SETTING** window set "**True Color 32 bit"** and "**1280 x 1024"** screen resolution and apply then press the "**Advanced"** button, press the "**Monitor"** flag and set the refresh frequency to "**75 Hz"**, save and quit pressing **APPLY** and then **OK** in all the opened windows and perform a re-boot
- Type the **DEL** key during the BIOS boot and enter in the **BIOS SETUP** menu typing the correct password (the same as the user **SERV**)
- Select the **BIOS FEATURES SETUP** menu and set the following Boot Sequence using the + and - keys: **1. IDE Hard Drive, 2. Removable Device, 3. ATAPI CDROM, 4. Other Boot Device**
- Quit from the BIOS SETUP saving the new configuration
- Perform the OPI SW Installation

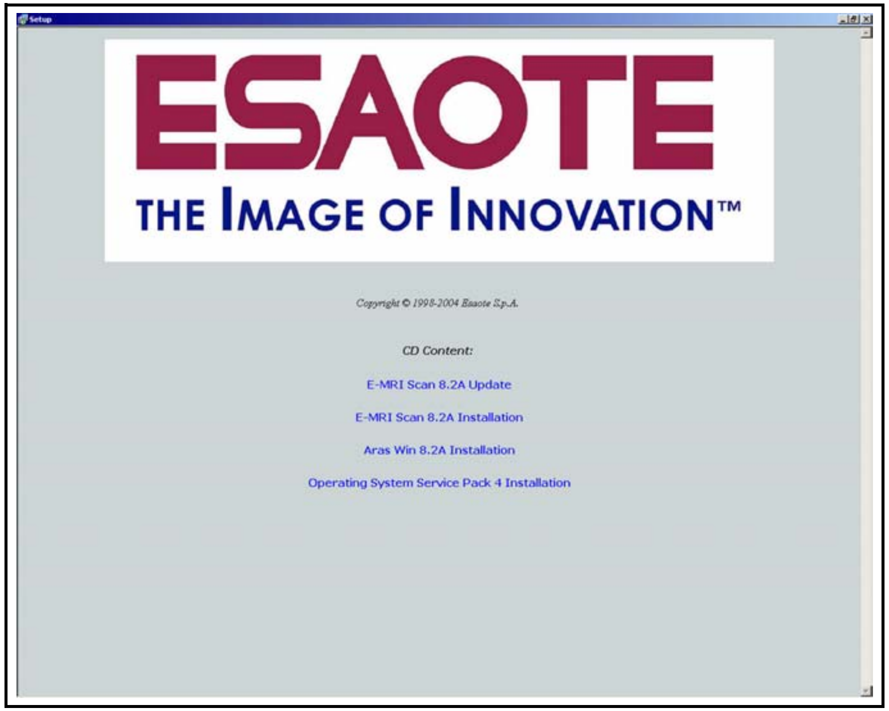
Operating System Service Pack 4 Installation

CAUTION **Perform this procedure before the OPI installation!!!**

The patch is contained into the ESAOTE SW Release CD-ROM!!!

- Insert the ESAOTE CD-ROM into the CD-ROM driver
- The following HTML page will be automatically displayed

Fig. 47: Selection page



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CD Content:

E-MRI Scan 8.2A Update

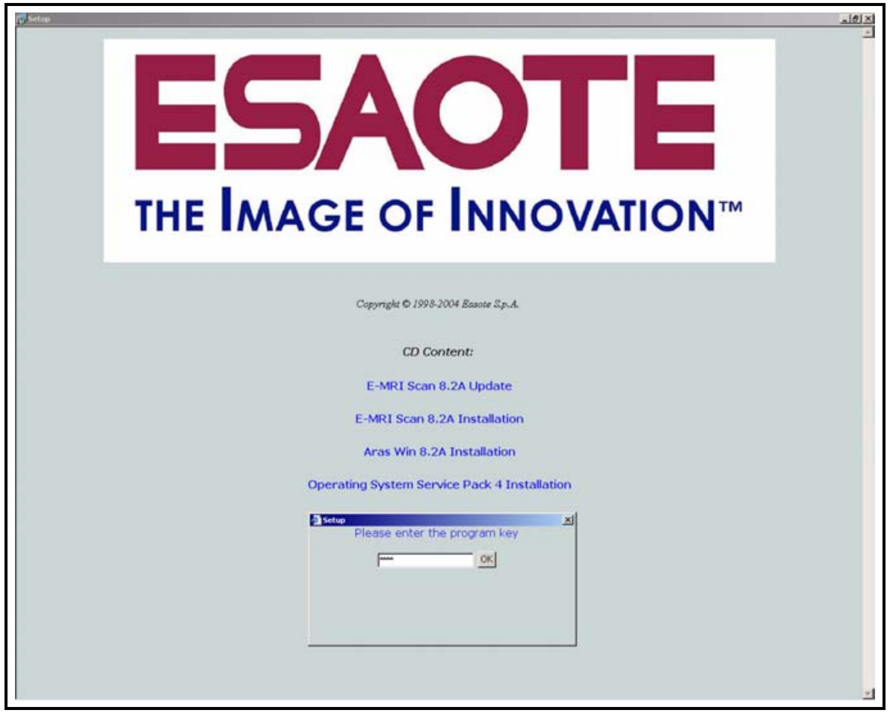
E-MRI Scan 8.2A Installation

Aras Win 8.2A Installation

Operating System Service Pack 4 Installation

- Select the **Operating System Service Pack4 Installation** and the system will ask you to insert the activation code
- In the next window write **1209** and confirm it pressing the **OK** button

Fig. 48: Selection page: code request



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CD Content:

E-MRI Scan 8.2A Update

E-MRI Scan 8.2A Installation

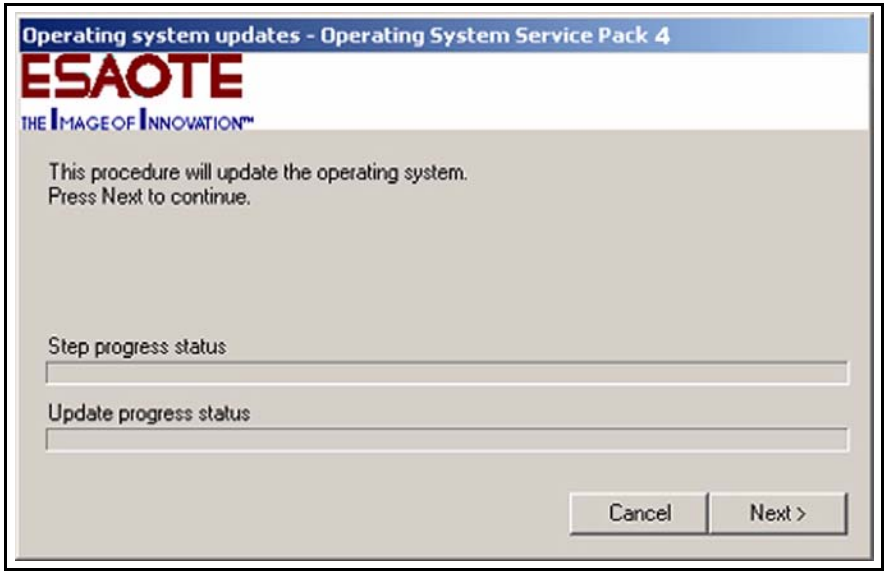
Aras Win 8.2A Installation

Operating System Service Pack 4 Installation

Please enter the program key

- In the next window press the NEXT button to start the OS patch installation

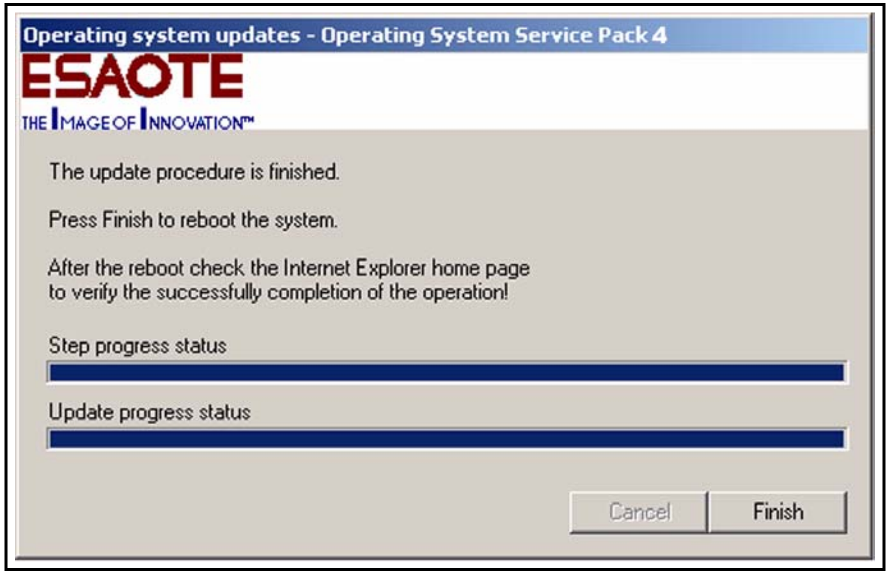
Fig. 49: WIN2000 SP4 installation



This procedure will update the operating system.
Press Next to continue.

- The procedure goes ahead automatically and will take more or less 20". The system will perform 20 automatic installation steps re-booting between the steps 2 to 3, 17 to 18 and 19 to 20. **Don't interact with the system and wait for the window shown in the next figure**
- When the next window appears click on the **FINISH** button to re-boot the system

Fig. 50: WIN2000 SP4 installed



The update procedure is finished.

Press Finish to reboot the system.

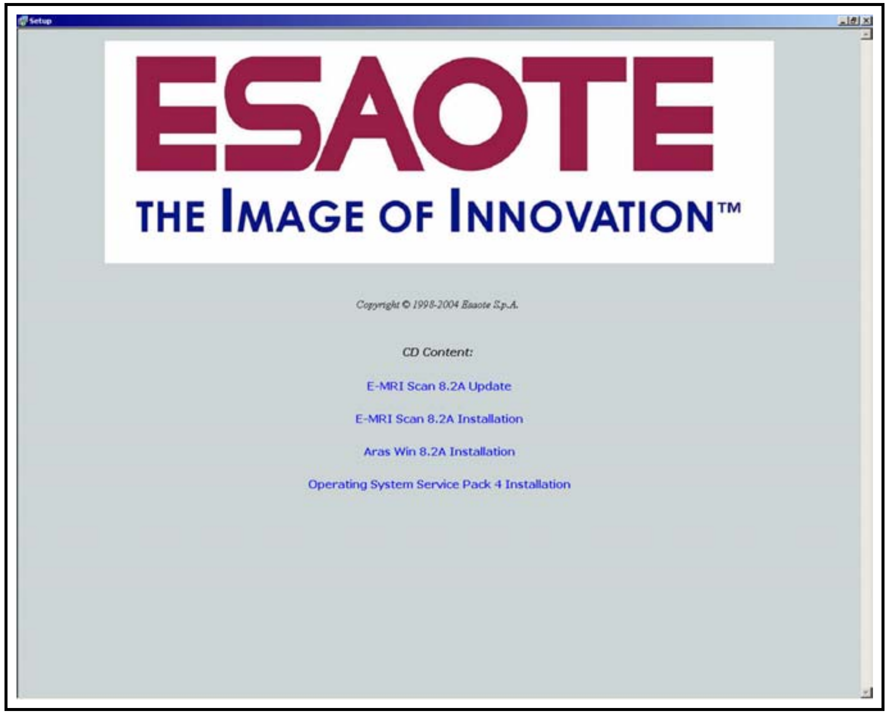
After the reboot check the Internet Explorer home page
to verify the successfully completion of the operation!

- Perform a log on as **ADMINISTRATOR** (no password required) to complete the patch installation then re-boot the system
- Proceed with the OPI SW Release installation

OPI SW Installation

- Switch on the System and perform the log on like user **ADMINISTRATOR** (no password required)
- Insert the ESAOTE CD, if already present open the CD-ROM drive and close it back to start the auto play function
- The following HTML page will be automatically displayed

Fig. 51: Selection page



Copyright © 1998-2004 Esaote S.p.A.

CD Content:

E-MRI Scan 8.2A Update

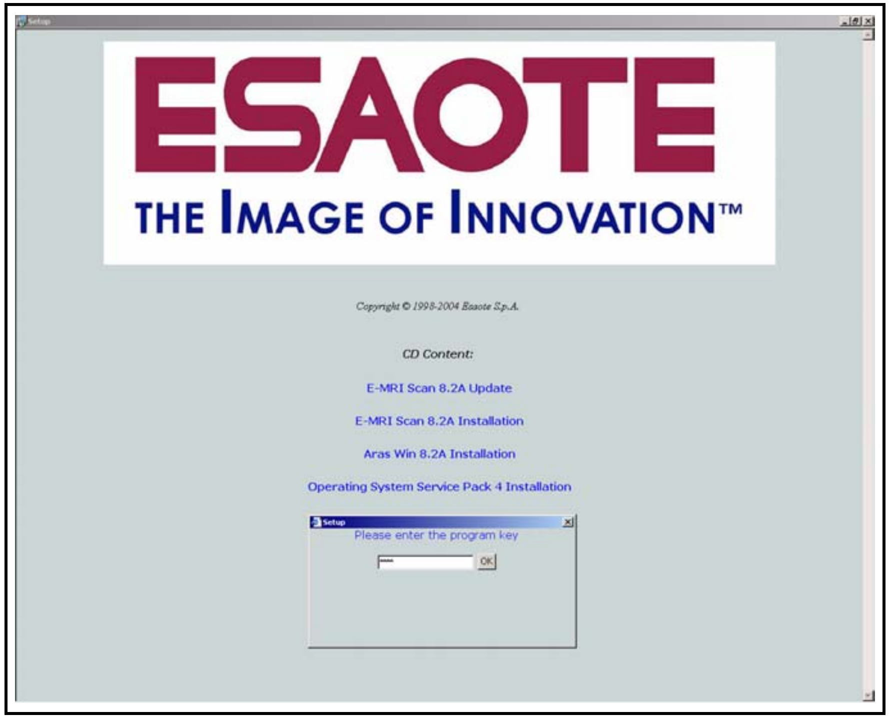
E-MRI Scan 8.2A Installation

Aras Win 8.2A Installation

Operating System Service Pack 4 Installation

- Select the **E-MRI Scan 8.1A Installation** and the system will ask you to insert the activation code

Fig. 52: Selection page: code request



Copyright © 1998-2004 Esaote S.p.A.

CD Content:

E-MRI Scan 8.2A Update

E-MRI Scan 8.2A Installation

Aras Win 8.2A Installation

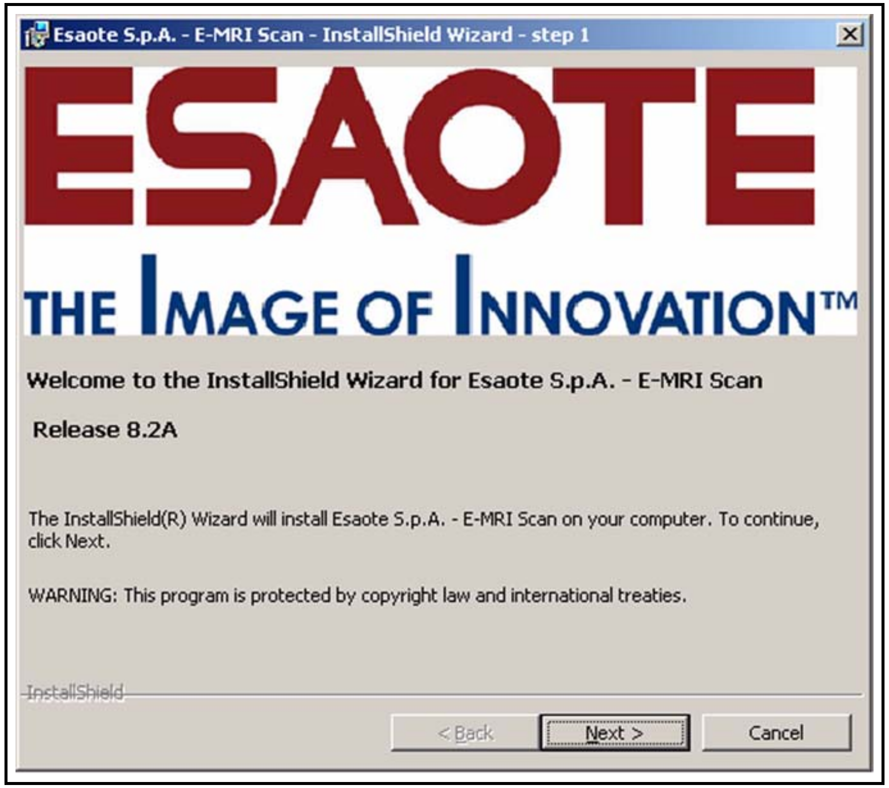
Operating System Service Pack 4 Installation

Setup

Please enter the program key

- Write **1611** and confirm it pressing the **OK** button to start the OPI installation
- When the next window appears click on the **NEXT** button

Fig. 53: 8.2A installation step 1



Welcome to the InstallShield Wizard for Esaote S.p.A. - E-MRI Scan

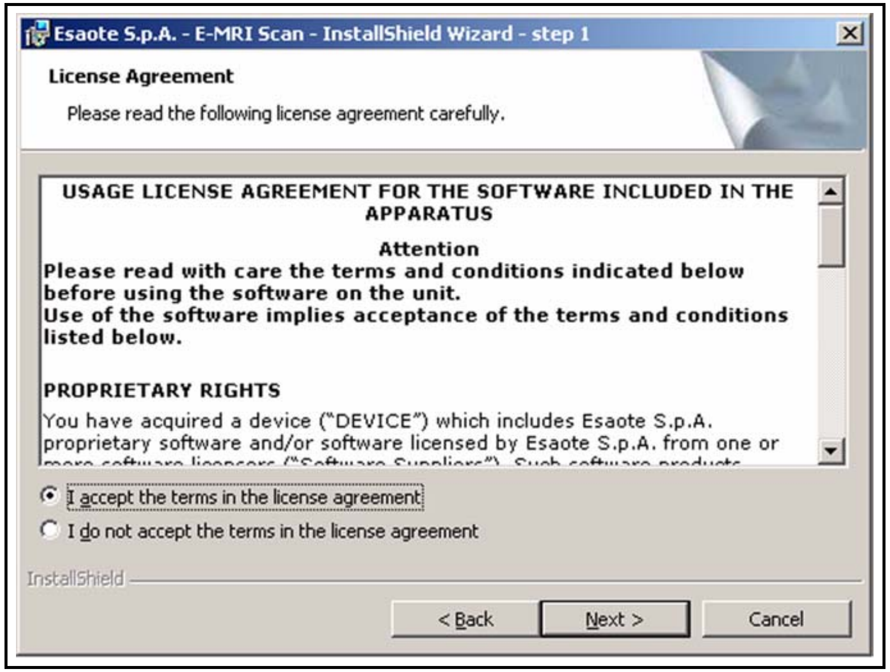
Release 8.2A

The InstallShield(R) Wizard will install Esaote S.p.A. - E-MRI Scan on your computer. To continue, click Next.

WARNING: This program is protected by copyright law and international treaties.

- When the next window appears click on the sentence "**I accept the terms in…"** then click on the **NEXT** button

Fig. 54: 8.2A installation step 2



License Agreement

Please read the following license agreement carefully.

USAGE LICENSE AGREEMENT FOR THE SOFTWARE INCLUDED IN THE APPARATUS

Attention

Please read with care the terms and conditions indicated below before using the software on the unit.
Use of the software implies acceptance of the terms and conditions listed below.

PROPRIETARY RIGHTS

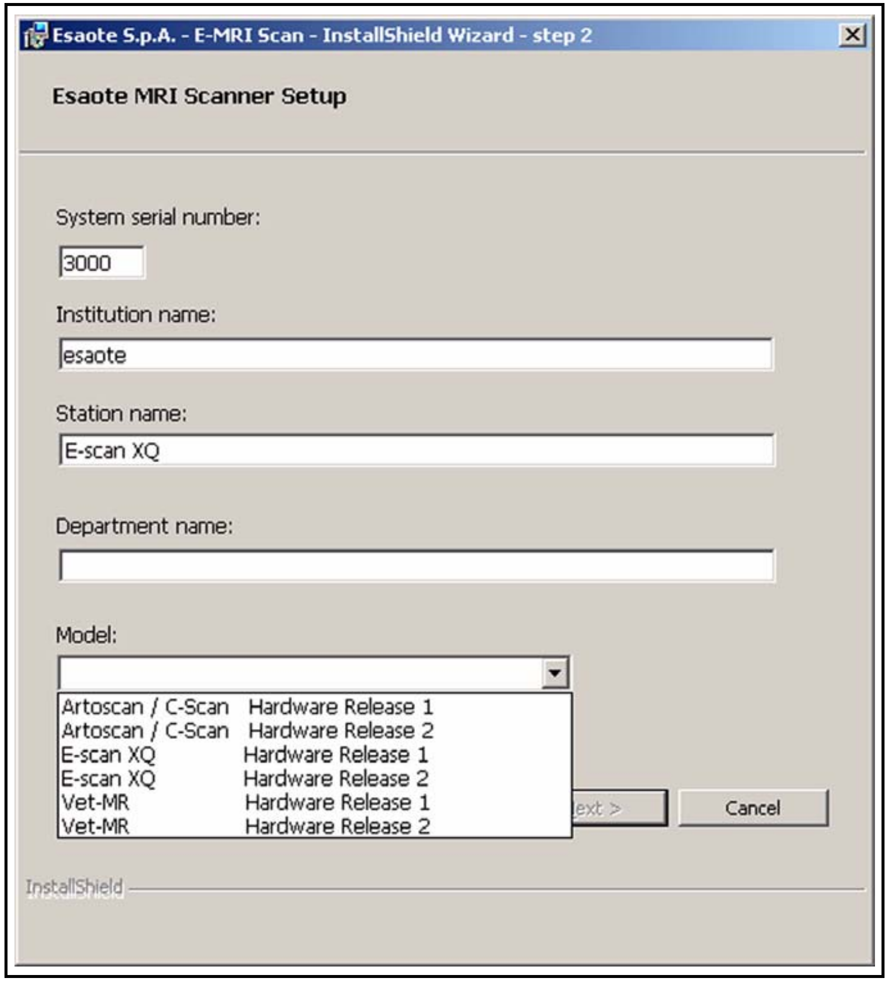
You have acquired a device ("DEVICE") which includes Esaote S.p.A. proprietary software and/or software licensed by Esaote S.p.A. from one or

● I accept the terms in the license agreement

○ I do not accept the terms in the license agreement

- The procedure goes ahead automatically and will take more or less 5". The system will perform the software installation steps. **Don't interact with the system and wait for the log on window (SERVCFG user, password as the user SERV)**
- Perform the log on as **SERVCFG** and when the next window appears insert the system own data or the generic data as shown in the next figure, remember that the system serial number must not start with 0 (zero), select the correct system you are installing then click on the **NEXT** button

Fig. 55: 8.2A installation point 3



Esaote S.p.A. - E-MRI Scan - InstallShield Wizard - step 2

Esaote MRI Scanner Setup

System serial number: 3000

Institution name: esaote

Station name: E-scan XQ

Department name:

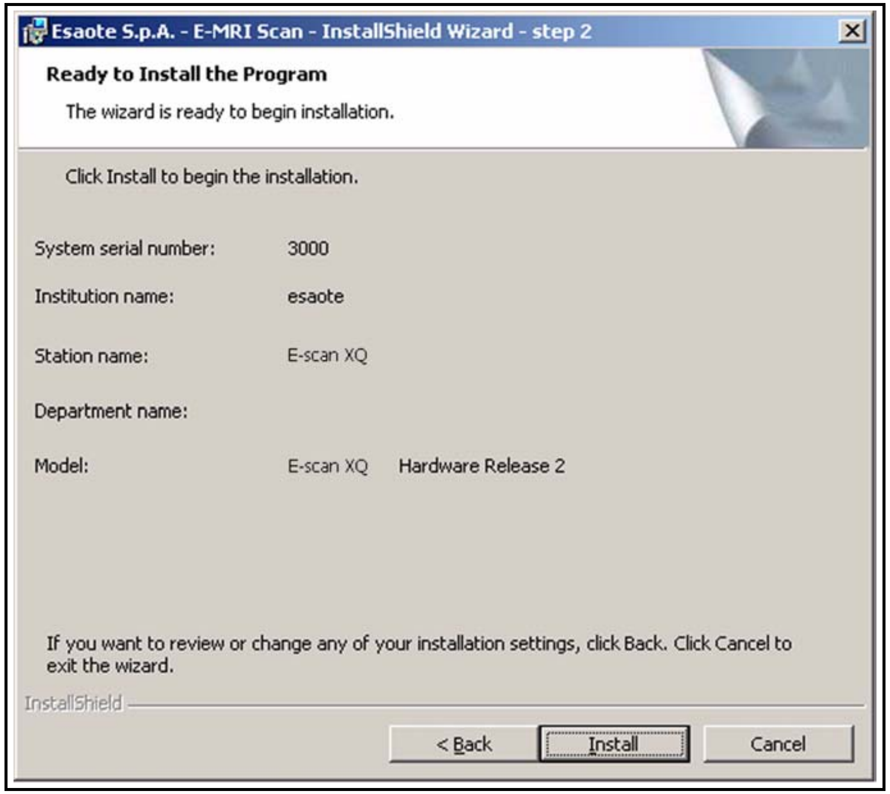
Model:

Artoscan / C-Scan	Hardware Release 1
Artoscan / C-Scan	Hardware Release 2
E-scan XQ	Hardware Release 1
E-scan XQ	Hardware Release 2
Vet-MR	Hardware Release 1
Vet-MR	Hardware Release 2

NOTICE	C-SCAN Hardware Release 2 means DGT-NE!!!

- Check if the inserted data are correct and click on the **INSTALL** button to proceed with the OPI installation otherwise go back clicking on the **BACK** button to change the inserted data

Fig. 56: 8.2A installation point 4



Esaote S.p.A. - E-MRI Scan - InstallShield Wizard - step 2

Ready to Install the Program

The wizard is ready to begin installation.

Click Install to begin the installation.

System serial number: 3000

Institution name: esaote

Station name: E-scan XQ

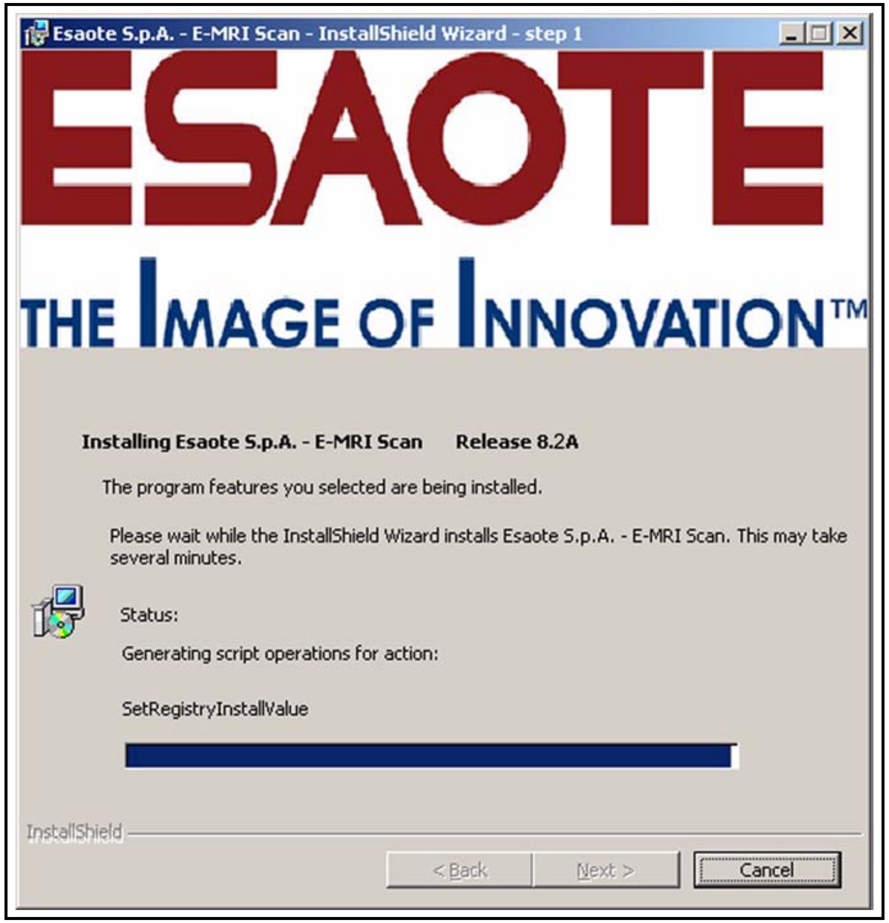
Department name:

Model: E-scan XQ Hardware Release 2

If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.

- The procedure goes ahead automatically and will take more or less 3". **Don't interact with the system till that the log on mask is shown!!!**

Fig. 57: 8.2A installation point 5 (installation)



Installing Esaote S.p.A. - E-MRI Scan Release 8.2A

The program features you selected are being installed.

Please wait while the InstallShield Wizard installs Esaote S.p.A. - E-MRI Scan. This may take several minutes.

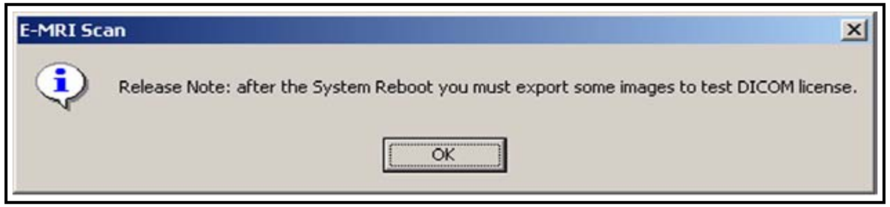
Status:

Generating script operations for action:

SetRegistryInstallValue

- If the following message appear click on the **OK** button

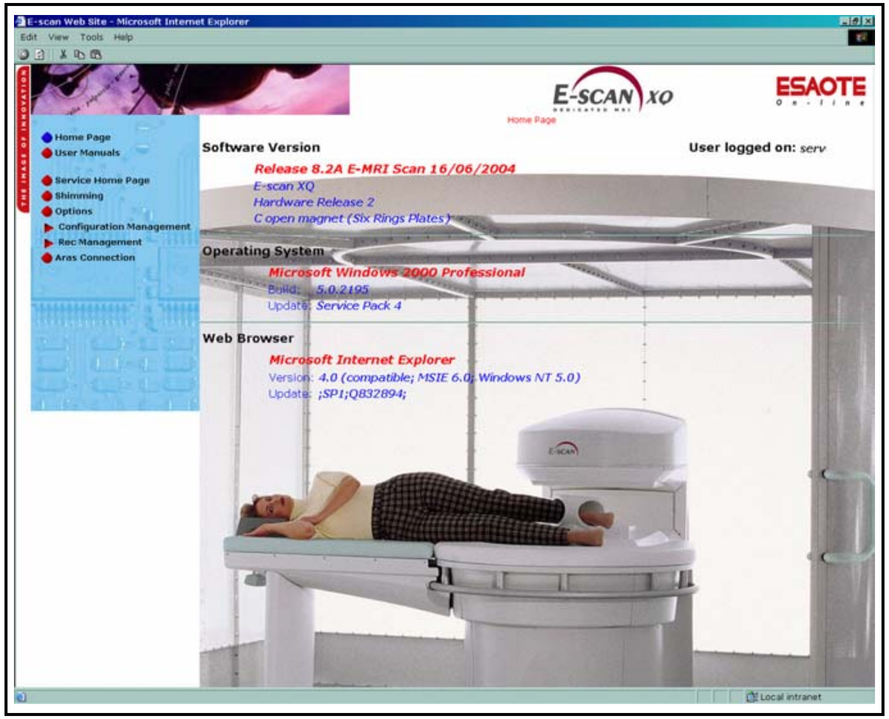
Fig. 58: 8.1A installation DICOM message



Release Note: after the System Reboot you must export some images to test DICOM license.

- After the last re-boot remove the ESAOTE CD-ROM and perform a log on with every user (**Serv**, **Servdriver**, **ESAMRI** and **ADMIN**)
- Perform a log-on as **SERV** and check in the IE homepage if the Operating System SP4 has been correctly installed (compare the shown data against the date shown in the following figure)

Fig. 59: IE homepage



Software Version

User logged on: serv

Release 8.2A E-MRI Scan 16/06/2004
E-scan XQ
Hardware Release 2
C open magnet (Six Rings Plates)

Operating System

Microsoft Windows 2000 Professional
Build: 5.0.2195
Update: Service Pack 4

Web Browser

Microsoft Internet Explorer
Version: 4.0 (compatible; MSIE 6.0; Windows NT 5.0)
Update: ;SP1;Q832894;

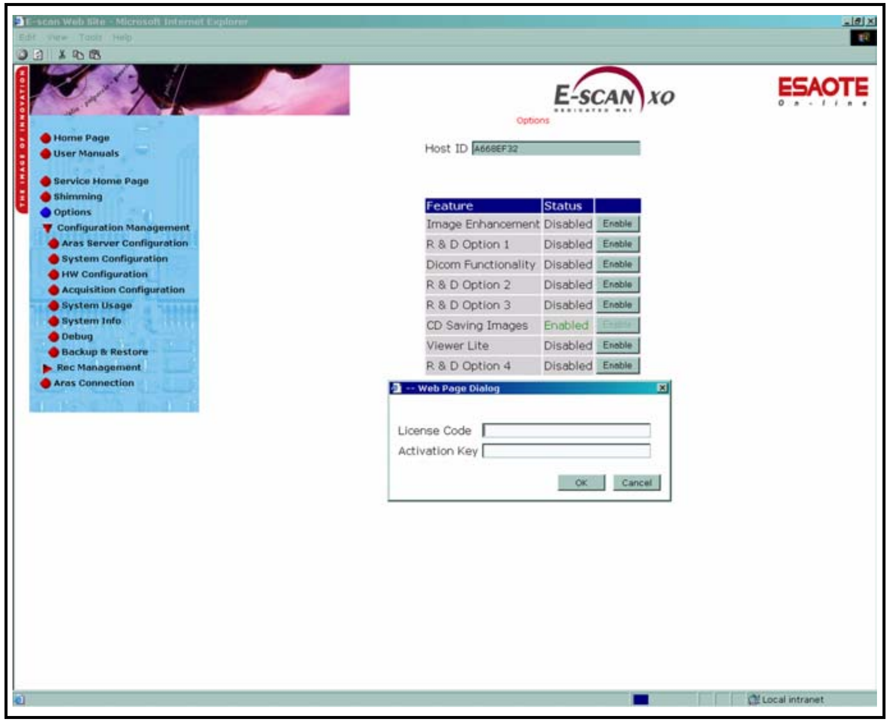
– Software Version
  ➩Release 8.2A E-MRI Scan 16/06/2004
  ➩E-SCAN XQ
  ➩Hardware Release 2
  ➩C Open Magnet (Six Rings Plates)

– Operating System
  ➩Microstate Windows 2000 Professional
  ➩Build: 5.0.2195
  ➩Update: Service Pack 4

– Web Browser
  ➩Microstate Internet Explorer
  ➩Version: 4.0 (compatible; MSIE 6.0; Windows NT 5.0)
  ➩Update:;SP1;Q832894

- Activate the system options opening the IE Options page. Could be necessary to insert and save the enabling codes.

Fig. 60: IE Options page



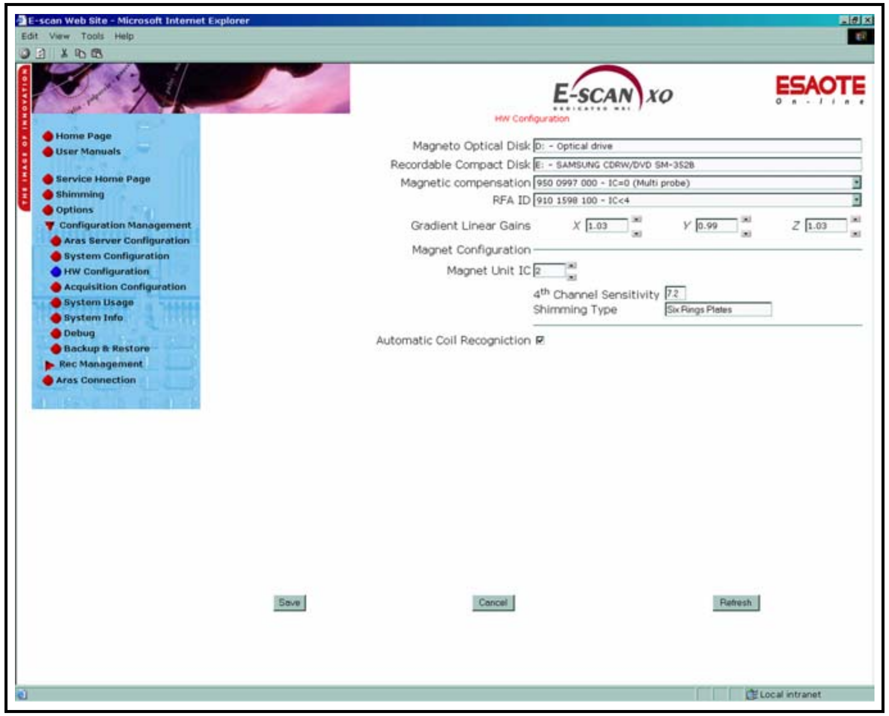
Host ID A668EF32

Feature	Status	
Image Enhancement	Disabled	Enable
R & D Option 1	Disabled	Enable
Dicom Functionality	Disabled	Enable
R & D Option 2	Disabled	Enable
R & D Option 3	Disabled	Enable
CD Saving Images	Enabled	Enable
Viewer Lite	Disabled	Enable
R & D Option 4	Disabled	Enable

License Code
Activation Key

- Set the Hardware Configuration page in according with your system component status

Fig. 61:   IE hardware configuration page



Magneto Optical Disk D: - Optical drive

Recordable Compact Disk E: - SAMSUNG CDRW/DVD SM-352B

Magnetic compensation 950 0997 000 - IC=0 (Multi probe)

RFA ID 910 1598 100 - IC<4

Gradient Linear Gains X 1.03 Y 0.99 Z 1.03

Magnet Configuration

Magnet Unit IC 2

4th Channel Sensitivity 7.2

Shimming Type Six Rings Plates

Automatic Coil Recogniction ☑

- The procedure is finished, proceed with the System restore or data inserting and/or calibrations

Page intentionally left blank.

Part 5 Host

Trouble shooting strategy

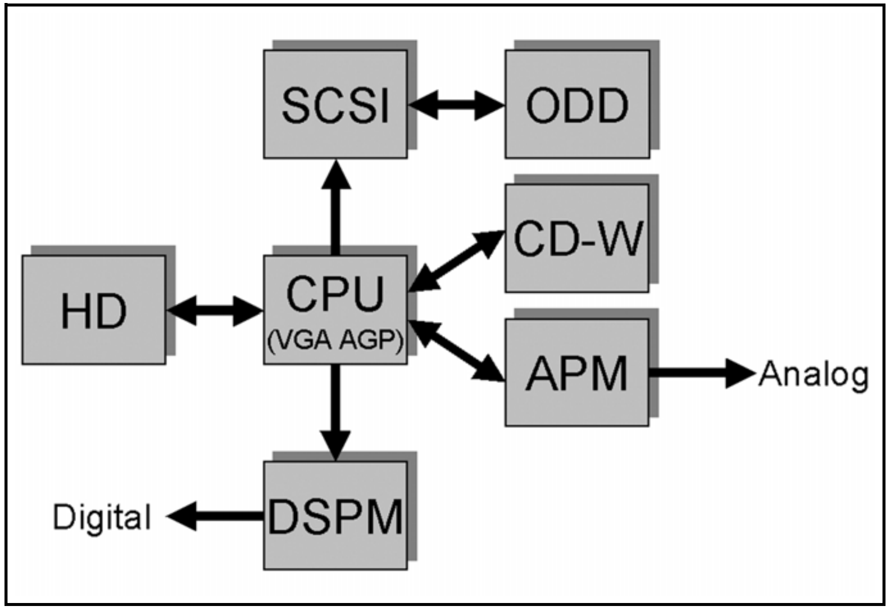
In this chapter you will find test strategies encompassing the complete host system.

Images visualization and storing

Image visualization and storing is an important system chain. It contains all the modules responsible for the last part of the image process.

The following figure shows which PC modules are in this chain.

Fig. 62: Image Visualization and Storing Chain

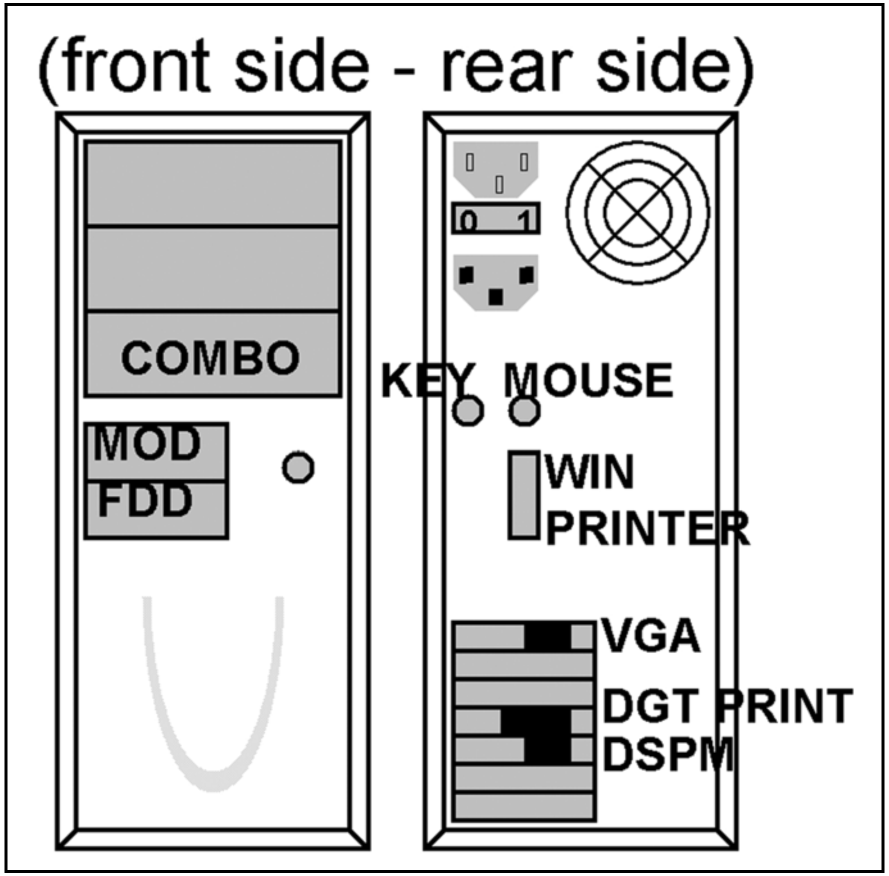


Procedure

This section is designed to give the CSE an in-depth description of trouble-shooting procedures for the complete host system.

Computer and Device Test

Fig. 63: PC Unit (rear view) and Card Positions



CPU Board

Switch on the system and press the “delete” key during the boot and insert the correct password (the same as the user SERV) to enter in the CPU board bios set-up.

Pentium IV: Award BIOS Setup Utility

Main

System Time	[xx:xx:xx]	Item Specific Help
System Date	[xx:xx:xx]	
Legacy Diskette A	[1.44, 3.5 in.]	
Floppy 3 Mode Support	[Disabled]	
Primary Master	[Auto]	
Primary Slave	[Auto]	
Secondary Master	[Auto]	
Secondary Slave	[Auto]	
Keyboard Feature		
Language	[English (US)]	
Supervisor Password	[Enabled]	
User Password	[Disabled]	
Hal On	[All Error]	
Installed Memory	1024 MB	

Advanced

CPU Speed	[2400 MHz]	Item Specific Help
CPU [18x]	[]	
CPU [133]	[]	
Memory Frequency	[Auto]	
AGP/PCI Frequency Setting	[Auto]	
CPU Vcore Setting	[Auto]	
CPU Vcore	[]	
DDR Reference Voltage	[Auto]	
AGP VDDQ Voltage	[Auto]	
CPU Level 1 Cache	[Enabled]	
CPU Level 2 Cache	[Enabled]	
BIOS Update	[Enabled]	
PS/2 Mouse Function Control	[Auto]	
USB Legacy Support	[Auto]	
OS/2 Onboard Memory >64 M	[Disabled]	
Chip Configuration		

Chip Configuration

SDRAM Configuration	[By SPD]	Item Specific Help
SDRAM CAS Latency	[]	
SDRAM RAS to CAS Delay	[]	
SDRAM RAS Precharge Delay	[]	
SDRAM RAS Precharge Delay	[]	
System Performance Mode	[Auto]	
SDRAM Idle Timer	[Auto]	
SDRAM Burst Length	[Auto]	
Memory Turbo Mode	[Disabled]	
SDRAM Refresh Rate	[By SPD]	
Graphic Aperture Size	[64 MB]	
AGP Capability	[4 X Mode]	
Video Memory Cache Mode	[USWC]	
Memory Hole At 15 M - 16 M	[Disabled]	
Delay Transaction	[Enabled]	

Power

Power Management	[User Defined]	Item Specific Help
Video Off Option	[Suspend → Off]	
Video Off Method	[DPMS OFF]	
HDD Power Down	[Disabled]	
ACPI Suspend To Ram	[Disabled]	
Suspend Mode	[Disabled]	
PWR Button < 4 sec.	[Soft Off]	
Power Up Control		
Hardware Monitor		

Power Up Control

AC Power Loss Restart	[Disabled]	Item Specific Help
Wake / Power Up On Next. Modem	[Disabled]	
Power Up On PCI Card	[Disabled]	
Power Up By PS/2 Keyboard	[Disabled]	
Power On By PS/2 Mouse	[Disabled]	
Automatic Power Up	[Disabled]	

Hardware Monitor

MB Temperature	xx °C/xx °F	Item Specific Help
CPU Temperature	xx °C/xx °F	
Power Temperature	[Ignore]	
Q-Fan Control	[Disabled]	
CPU Fan Speed	xxxx RPM	
Chassis Fan Speed	N/A	
Power Fan Speed	N/A	
VCORE Voltage	XxxV	
+3.3 V Voltage	XxxV	
+5 V Voltage	XxxV	
+12 V Voltage	XxxV	

Boot

IDE Hard Drive	[STxxxxxxX]	Item Specific Help
Removable Device	[Disabled]	
ATAPI CD-ROM	[Disabled]	
Other Boot Devices	[Disabled]	
Plug & Play O/S	[Yes]	
Reset Configuration Data	[No]	
Boot Virus Detection	[Enabled]	
Quick Power On Self Test	[Enabled]	
Boot Up Floppy Seek	[Enabled]	
Full Screen Logo	[Disabled]	
Interrupt Mode	[APIC]	

Hard disk

The hard disk must be set at “Master”. Look for the jumpers at the back of the HD and look at the labels at the top for its correct configuration.

Connect it to the Mother Board IDE1 connector, it must be recognized like Primary Master.

CD Combo

Set the CD Combo (CD Burner and DVD reader) as “Master”. Look for the jumpers at the back of the CD Combo and look at the labels at the top for its correct configuration.

Connect it to the Mother Board IDE2 connector (same cable as ODD), it must be recognized like Secondary Master.

Optical Disk Drive

Set the ODD as “Slave” setting the jumpers in the following configuration:

- 1-2 Open
- 3-4 CLOSE
- 5-6 Open

Connect it to the Mother Board IDE2 connector (same cable as the CD Combo), it must be recognized like Secondary Slave.

Repair instructions

In this chapter you will find repair instructions encompassing the complete host system.

Computer board set-up

The table lists the adjustments required after replacing individual boards or assemblies.

Tab. 7: Test and adjustment

MODULE	TEST	ADJUSTMENT
Motherboard	Switch on the system and perform some operations	No adjustment required
HD	Switch on the system and perform some operations	Insert back all the system data (using the system back-up or manually)
VGA	Switch on the system and perform some operations, check in device manager is the device is correctly recognized	No adjustment required
OPTICAL DISK DRIVE	Try to receive or send some images to the ODD, check in device manager is the device is correctly recognized	Check the jumper and deep switches settings
APM	Switch on the system and perform some operations, try to send images to the Analog Printer if present	No adjustment required
CD Combo	Try to receive or send some images from/to the CD Combo, check in device manager is the device is correctly recognized	Check the jumper and deep switches settings

Part 6 Control

Trouble Shooting Strategy

This chapter contains the test strategies encompassing the complete control system.

Procedure

This part contains the exchange procedures and the necessary adjustment procedures. Please observe normal safety precautions in connection with the particular area in which you are working and overall safety precautions in general.

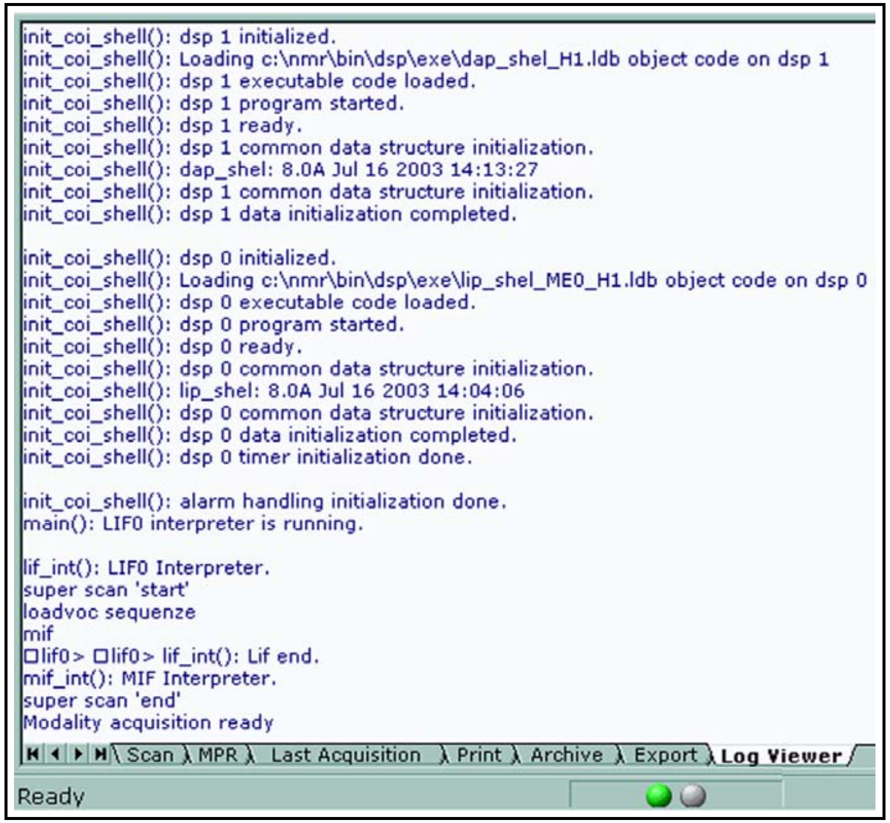
This part is designed to give the CSE an in-depth description of trouble-shooting procedures for the complete control system.

DSPM and Signal Box tests

Operation

- Switch on the system and perform the log on as SERV
- When OPI is open click on the **LOG Viewer** tab (bottom part of the window) and check if the DSP0 and DSP1 circuits present inside the DSPM card (contained into the PC Unit) are correctly initialized (as shown in the next figure). If you read an error message means that the card doesn't work properly

Fig. 64: DSP1 and DSP0 (both present inside the DSPM card contained into the PC Unit) correct initialization



```
init_coi_shell(): dsp 1 initialized.
init_coi_shell(): Loading c:\nmr\bin\dsp\exe\dap_shel_H1.ldb object code on dsp 1
init_coi_shell(): dsp 1 executable code loaded.
init_coi_shell(): dsp 1 program started.
init_coi_shell(): dsp 1 ready.
init_coi_shell(): dsp 1 common data structure initialization.
init_coi_shell(): dap_shel: 8.0A Jul 16 2003 14:13:27
init_coi_shell(): dsp 1 common data structure initialization.
init_coi_shell(): dsp 1 data initialization completed.

init_coi_shell(): dsp 0 initialized.
init_coi_shell(): Loading c:\nmr\bin\dsp\exe\lip_shel_ME0_H1.ldb object code on dsp 0
init_coi_shell(): dsp 0 executable code loaded.
init_coi_shell(): dsp 0 program started.
init_coi_shell(): dsp 0 ready.
init_coi_shell(): dsp 0 common data structure initialization.
init_coi_shell(): lip_shel: 8.0A Jul 16 2003 14:04:06
init_coi_shell(): dsp 0 common data structure initialization.
init_coi_shell(): dsp 0 data initialization completed.
init_coi_shell(): dsp 0 timer initialization done.

init_coi_shell(): alarm handling initialization done.
main(): LIF0 interpreter is running.

lif_int(): LIF0 Interpreter.
super scan 'start'
loadvoc sequenze
mif
□lif0> □lif0> lif_int(): Lif end.
mif_int(): MIF Interpreter.
super scan 'end'
Modality acquisition ready
```

- If the DSP 0 initialization is not completed (e.g. the program stops at the line “dsp 0 program started”) the problem could be in the data cable or in the cards present inside the signal box:
  - First of all check if the MOM is properly powered (the four leds, two green and two reads, must be on and not flashing). These leds are visible through the grid present on the Signal Box front side

Fig. 65: Signal Box leds and test points (lateral view)

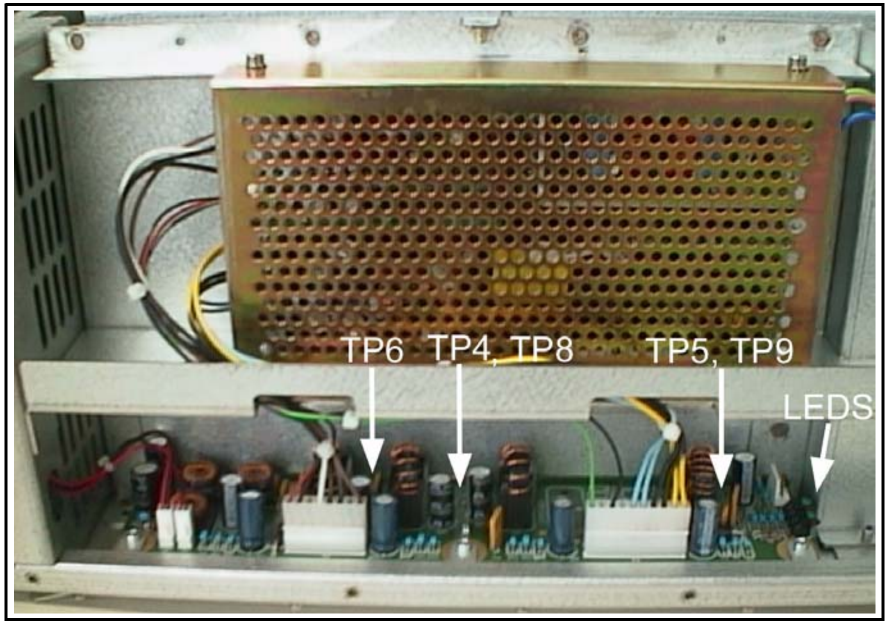
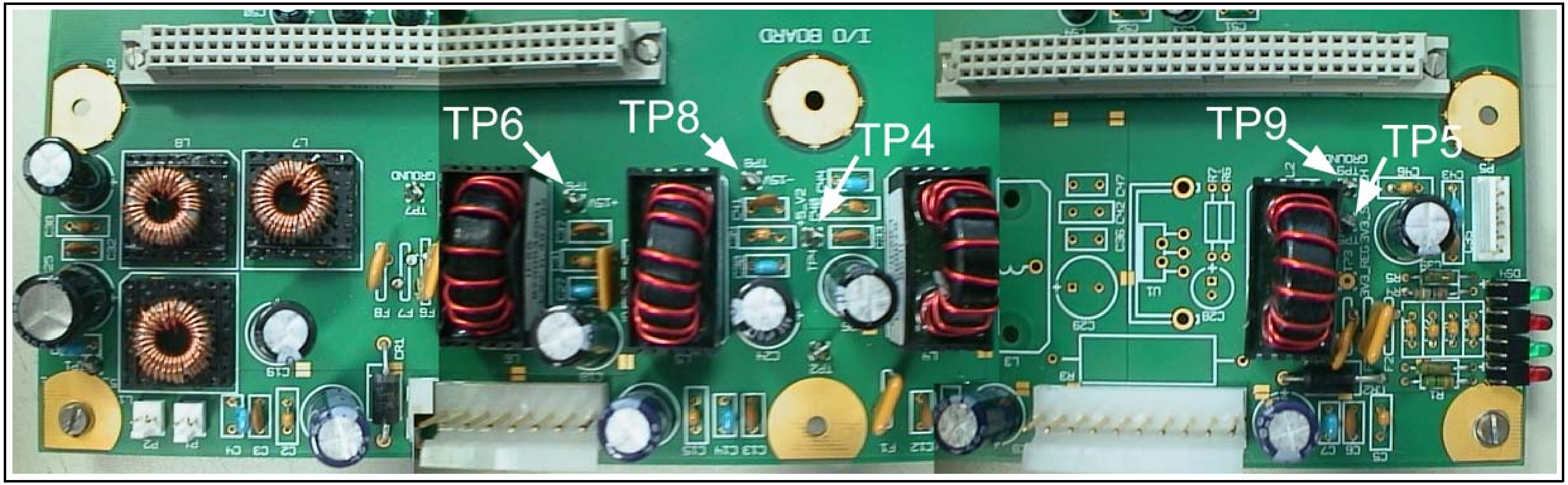


Fig. 66: MOM Bus Test Points (top view of the left part of the MOM bus)



- Then check if the voltage values measured on the following test points are correct (close to these values). To perform this test you have to open the Signal Box and power it, then identify the Test Points on the MOM from the Signal Box left side (right under the signal Box Power Supply):

  Between TP5 and TP9 = 3.4 V

  Between TP4 and ground (Signal Box chassis) = 5.4 V

  Between TP8 and ground (Signal Box chassis) = -14.9 V

  Between TP6 and ground (Signal Box chassis) = 14.9 V

- If all the previous tests give you a correct result remove one board per time (RFM and MTCM) and check if without them it's possible to complete the DSPM initialization program

Data Cable Check

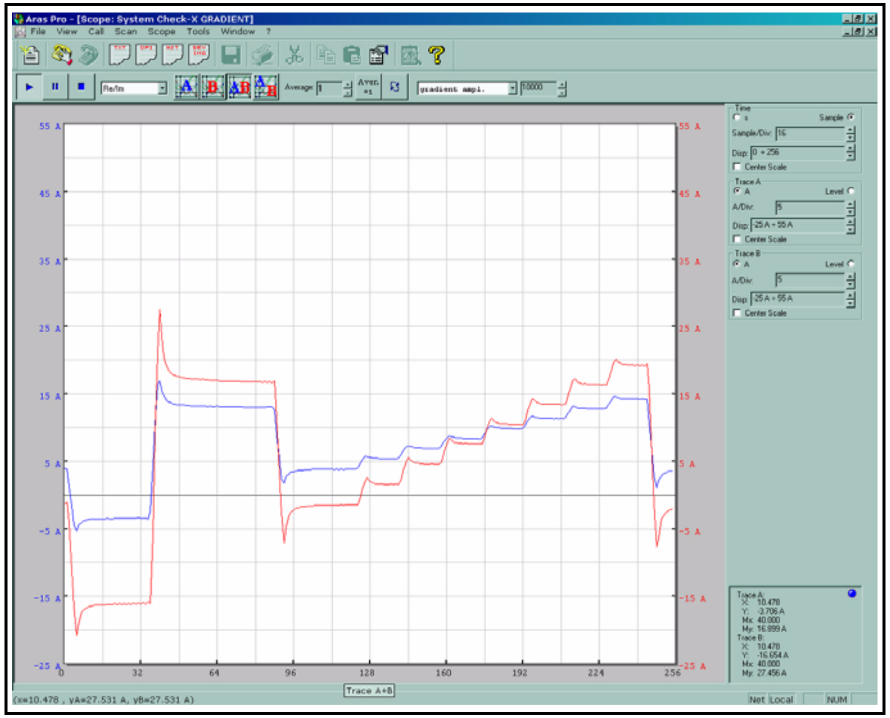
Disconnect the Data Cable connected to the PC Unit and the ACM card and verify that the cable pin out is pin to pin (1 to 1; 2 to 2; 3 to 3; etc.) except for the connectors 5, 10 and 11 that are not connected.

ACM test

Operation

- Switch on the system
- Under ARAS, select **<Test> < Troubleshoot.> <System check>**
- If no traces are present the ACM is broken
- Click on Channel field and select the gradients X, Y Z and 4th CH. The red trace is the output from the SGRA; the blue trace is the input from the ACM board.
  - If the blue traces are flat, the ACM board is broken
  - If the red traces are flat but the blue traces are present means that the cable between the ACM board and the SGRA module could be broken, or the GRA is broken (or not powered) or the GRA is disabled (by the MTCM because the Magnet temperature is incorrect)
  - Remember that all the signals are collected by the ACM board and if the trace is displayed on monitor doesn't mean that reaches the module correctly! If only one red trace is flat and all the other traces (red and blue) are present try to invert the gradient cable (you can swap X with Y, Y with Z but never swap Z with IV CH!!!), if you are able to move the problem to another channel means that the problem is after the SGRA, if you are not able to move it means that one channel of the SGRA is broken

Fig. 67: System check


Aras Pro - [Scope: System Check-X GRADIENT]

Average: 1

gradient ampl.

10000

Time: Sample
Sample/Div: 16
Disp: 0 ÷ 256
☐ Center Scale

Trace A: A
A/Div: 5
Disp: -25 A ÷ 55 A
☐ Center Scale

Trace B: A
A/Div: 5
Disp: -25 A ÷ 55 A
☐ Center Scale

Trace A:
X: 10.478
Y: -3.706 A
Mx: 40.000
My: 16.899 A
Trace B:
X: 10.478
Y: -16.654 A
Mx: 40.000
My: 27.456 A

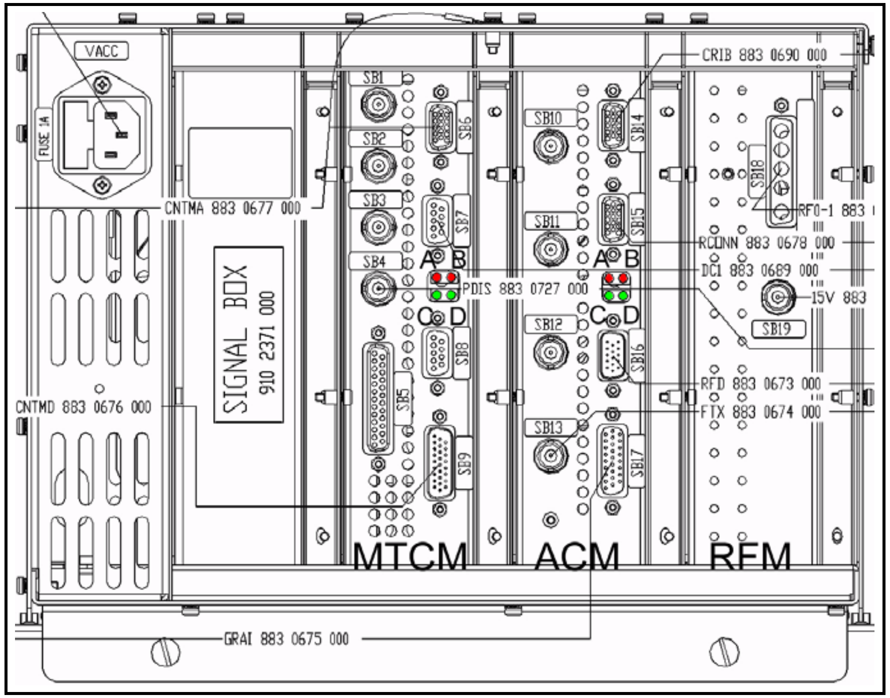
(x=10.478 , yA=27.531 A, yB=27.531 A)

- Open the Electronic Unit and check the ACM led status meaning, in case of error count the number of blinking after a pause:

Tab. 8: ACM led status meaning

Led	Normal	Error	Error Meaning
A	Off	Blinking	The ACM is broken (refer to the Led A blinking meaning table)
B	Off	Blinking	The ACM is broken (refer to the Led B blinking meaning table)
C	Blinking (0,5 sec.)	Off	the ACM is broken or there is a communication problem between DSPM and ACM
D	Blinking (1 sec.)	Off	the ACM is broken or there is a communication problem between DSPM and ACM

Fig. 68: Signal Box (inside the Electronic Unit)



Tab. 9: Led A blinking meaning table

Number of Blinking	**Meaning**
1	Interrupt vector for status stack/loop stack overflow or PC stack full
2	Interrupt vector for external interrupts
3	Interrupt vector for DAG1 buffer 7 circular buffer overflow
4	Interrupt vector for DAG2 buffer 15 circular buffer overflow
5	Interrupt vector for fixed point overflow interrupt
6 - 9	Interrupt vectors for user interrupts 0 - 7
13	Interrupt vectors for illegal input condition detected
14	Interrupt vectors for link buffer 0
15	Interrupt vectors for link buffer 1
16	Interrupt vectors for SPIRX
17	Interrupt vectors for SPITX
18	Interrupt vectors for link buffer 4
19	Interrupt vectors for link buffer 5
20 - 27	Interrupt vectors for External port DMA channels

Tab. 10: Led B blinking meaning table

Number of Blinking	**Meaning**
1	Interrupt vector for status stack/loop stack overflow or PC stack full
2	Interrupt vector for external interrupts
3	Interrupt vector for DAG1 buffer 7 circular buffer overflow
4	Interrupt vector for DAG2 buffer 15 circular buffer overflow
5	Interrupt vector for fixed point overflow interrupt
6 - 9	Interrupt vectors for user interrupts 0 - 7
14	Interrupt vectors for link buffer 0
15	Interrupt vectors for link buffer 1
16	Interrupt vectors for SPIRX
17	Interrupt vectors for SPITX
18	Interrupt vectors for link buffer 4
19	Interrupt vectors for link buffer 5
22	Interrupt vectors for Link port service request
29	Interrupt vectors for illegal input condition detected

Repair instructions

This chapter contains repair instructions encompassing the complete control system.

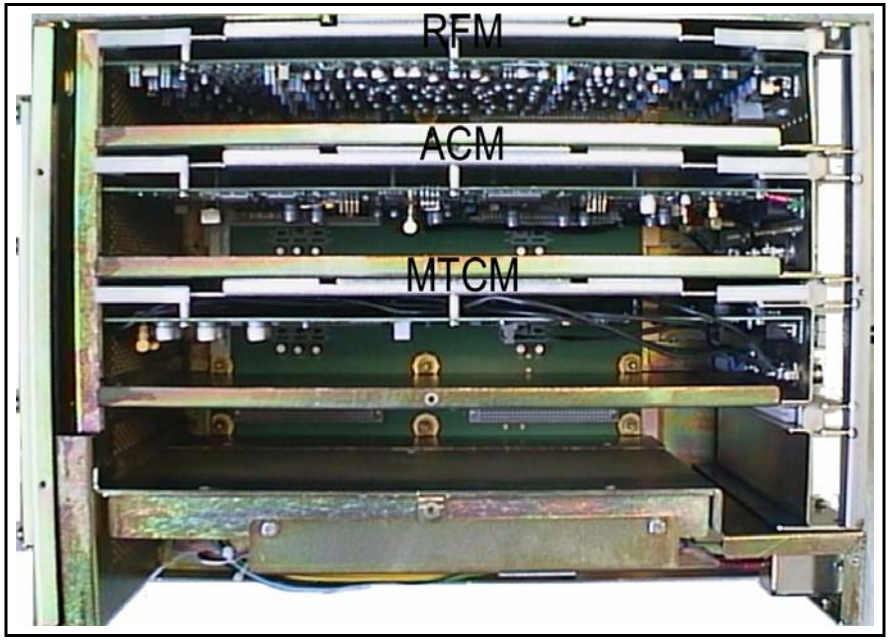
Change DSPM card

- Shut down the System
- Disconnect all the cables connected to the PC unit
- Open the PC unit
- Take out the broken card and change it
- Close the PC unit
- Re connect all the cables
- Close the Console
- Refer to the following table for necessary tests and adjustment

Change ACM module

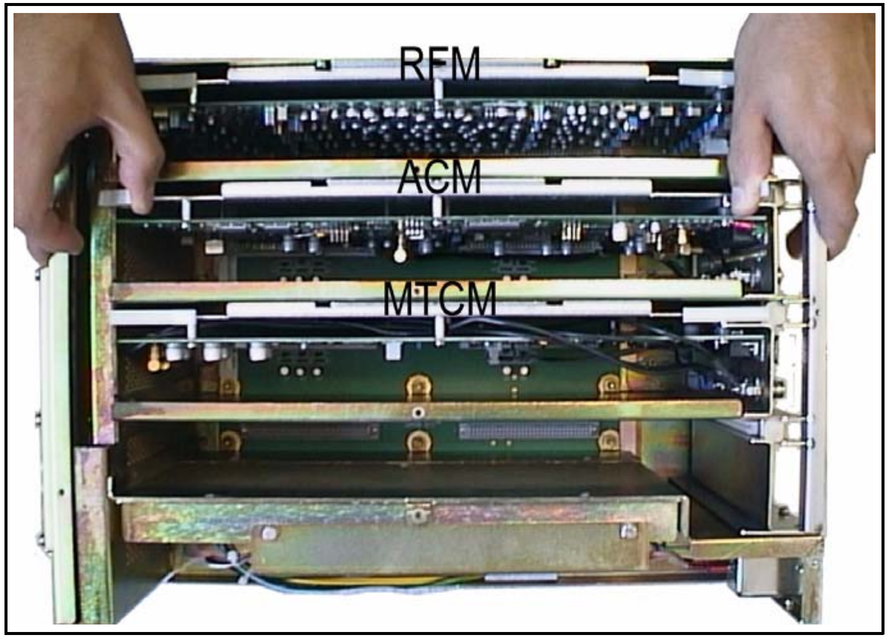
- Shut down the System
- Open the electronic Unit
- Remove the rear power plug and the from cables from the Signal Box
- Remove the Signal Box and open it (removing the screws from the upper cover)

Fig. 69: Opened Signal Box



- Extract and replace the ACM board with the new one

Fig. 70: How to remove a board from the Signal Box



- Close the Signal Box
- Place it into the Electronic Unit and replace all the cable (also rear power cable)
- Close the Electronic unit
- Refer to the following table for necessary tests and adjustment

Tab. 11: Test and adjustment

MODULE	**TEST**	**ADJUSTMENT**
DSPM	Check if the card is correctly initialized by OPI	No adjustment required
ACM	Go to Under ARAS, select <**Test**> <**Troubleshoot.**> <**System check**> and look for the gradient the X, Y, Z and 4th CH input to the SGRA module	ECC Tune

Part 7 RF Subsystem

Trouble Shooting Strategy

General

One of the essential prerequisites for the excellent image quality of an MR- system is a correct and stable RF system.

However, due to the complexity of a MR- system, image quality is influenced by a great variety of components and functions, such as

- Communication systems (e. g.: general data transfer,.)
- Control systems (e. g. Host,...)
- Image generating systems (e. g. RF system, gradient system,.)
- Image acquisition, processing and archiving systems
- Software performance

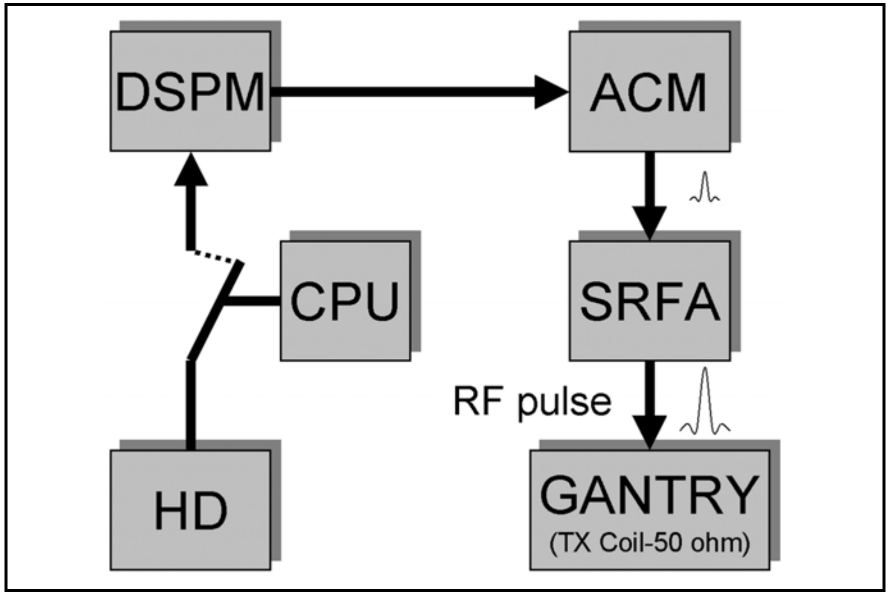
For more explanations about the module described in this chapter refer to the Functional Description manual RF chapter.

Procedure

Transmitting Coil Driving

A description of the process and identification of the modules responsible for the transmission process is shown in the following figure.

Fig. 71: Transmission chain description (coil driving)



The control software operating on DSPM (inside the PC Unit) sends the digital commands necessary for driving the transmission coil to the ACM (inside the Signal Box of the Electronic Unit). These commands are processed (multiplexed and synchronized) by the ACM, then it processes the commands digitally and sends the driving RF signal to SRFA (in connector RF). It sends the GATE signal to enable the SRFA as well. The SRFA amplifies the RF signal (impulse) and sends it through RFOUT connector to the SRFAOUT of the filter panel connected to the MBTX connector of the magnet panel (BTX, flexible pressed matter circuit, fixed inside GANTRY). On SRFA there is another connector called CONTROL connected (RFD cable) to the ACM module. Inside the CONTROL connector, there are the reference signals from reflected and direct RF power, GATE signal and ALARM SRFA signal.

Use of system Check

You can display reflected and direct RF power using **<System Check>**,. Selecting **<Channel>** = “**4”** and **<Channel>** = “**5”**, you can examine the envelope of the RF pulse, as measured at the RF amplifier output (SRFA module) by a reflectometer. It gives a voltage proportional to the square root of the transmitted power (Pd - blue trace or channel A), another voltage proportional to the square root of the reflected power (Pr – red trace or channel B).

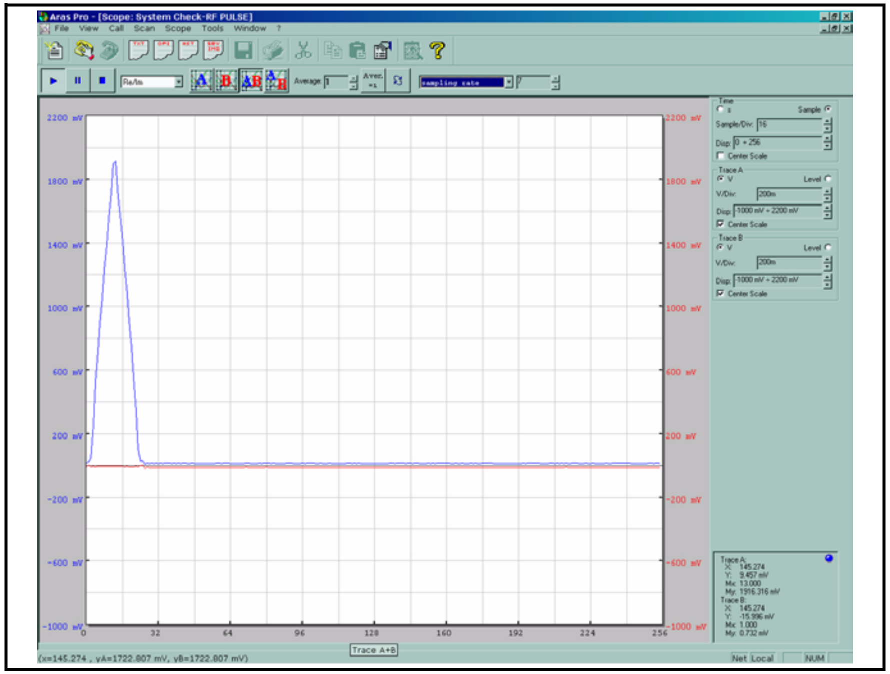
- If their ratio (Pd/Pr) is close to 1, you can locate the error by connecting a 50-Ohm load to RFOUT connector of the SRFA module:
- If you still have Pd/Pr=1 means that the SRFA is broken

If you have a Pr almost equal to 0 (like in the next figure) means that the problem is after the SRFA (cable, filter panel or TX Coil), if you have to flat lines probably the ACM is broken.

Check if the transmission circuits in the gantry are tuned to the correct frequency, which may be out of tune or not-adjusted. If the frequency is correct, check the tuning capacitor inside the gantry with a tester to identify any open or short circuit. It is thus possible to check both the correct envelope form (generated with the contribution of the DSPM and ACM modules and, of course, of the SRFA module) and the quality of the coupling with the transmission coil (BTX). If the ratio between the two direct and reflected voltages (measurable in **<Pause>**) is less than 4 there may be a tuning problem on the transmission coil or a malfunction in the SRFA output.

If the ratio is close to 1 (e.g. the traces are virtually overlapping), the SRFA-BTX connection may be broken. In this case too, before displaying the two signals, click on **<Scale>**, then select the **<Dec>** mode on the y axis, so that the values on the y grid will be expressed in Volts. The following figure shows the RF pulse using **<V/Div.>** = 0.2 V and **<Sample Div.>** = 16 (sample). The window information shows the values in Volts of the transmitted (channel A) and of the reflected power (channel B).

Fig. 72: Direct and reflected pulse visualization



Time
○ s Sample ●
Sample/Div: 16
Disp: 0 ÷ 256
☐ Center Scale

Trace A
● V Level ○
V/Div: 200m
Disp: -1000 mV ÷ 2200 mV
☑ Center Scale

Trace B
● V Level ○
V/Div: 200m
Disp: -1000 mV ÷ 2200 mV
☑ Center Scale

Average: 1

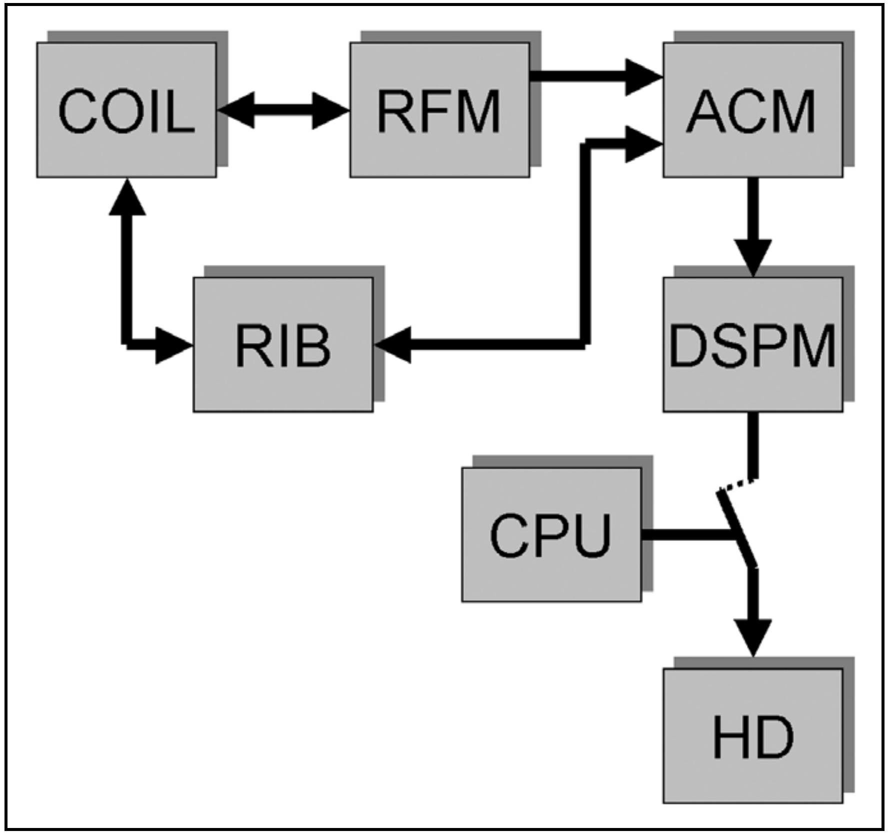
Trace A:
X: 145.274
Y: 9.457 mV
Mx: 13.000
My: 1916.316 mV
Trace B:
X: 145.274
Y: -15.996 mV
Mx: 1.000
My: 0.732 mV

(x=145.274 , yA=1722.807 mV, yB=1722.807 mV)

Receiving chain driving

A description of the process and which modules are responsible for the receiving process is shown in the following figure.

Fig. 73: Receiving channel description



The **RF signal** picked up by the reception linear coil (BRX) is sent through the cables to the RFM module through the filter panel.

Within the RFM, the RF signal is amplified or reduced in order to keep constant its value then is converted to the average frequency of 3 MHz by the mixer and the local oscillator.

The signals are now sent to the ACM board that performs the signal demodulation (using a signal that generates itself) and sends the raw data to the DSPM that performs the image reconstruction.

The RIB module is installed under the magnet; this box is the card devoted to automatic coil acknowledgement. It receives the power from the ACM board and sends to it the data related to the

The **Varicap** (varicaps in case of DPA coil) driving signal (necessary for the fine-tuning of the coil) is sent to the Coil by the RFRM that receives the info related to the correct Varicap value from the ACM board. The voltage can vary between 0 to 9 V (center 2.1 V) depending on the digital value, between 0 and 255.

Use **Coil Tuning** test to check the coil varicap signals (under ARAS, select **<Manual> <Coil Tuning>**).

Automatic Coil Recognition

If the automatic coil recognition doesn't work the system doesn't allow you to perform any scan. An easy work around for this problem in order to continue the patient's examinations waiting for a new part is disabling it.

To do that perform a log on as ESAMRI, open Internet Explorer, select System Management and then open the page HD Configuration then uncheck the Automatic Coil Recognition flag and save the new configuration clicking on the SAVE button

RFM check

Procedure

- Under ARAS, select <Manual> <Coil Tuning> and check if you can move the visualized signal changing the varicap value
- If you cannot move it try to use another coil (or open the Coil and try to measure the Varicap value direct from the test points – refer to the Receiving Coils Check paragraph contained in this chapter)
- If you still have the same result try to change the RFM module and then the ACM board

ACM and SRFA check

Procedure

You can display reflected and direct RF power using **<System Check>**. Selecting **<Channel>** = “**4”** and **<Channel>** = “**5”**, you can examine the envelope of the RF pulse, as measured at the RF amplifier output (SRFA module) by a reflectometer. It gives a voltage proportional to the square root of the transmitted power (Pd - blue trace or channel A), another voltage proportional to the square root of the reflected power (Pr – red trace or channel B).

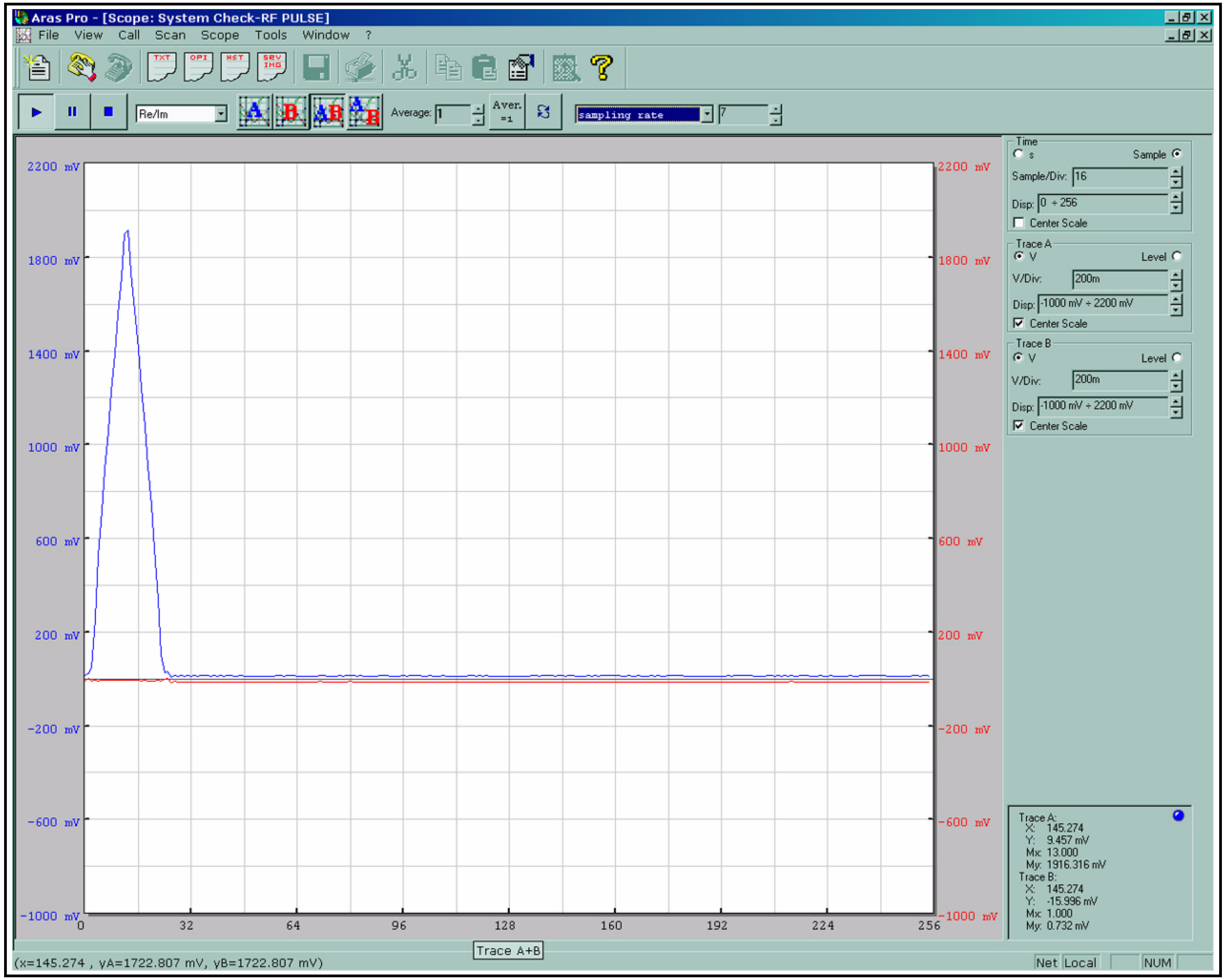
It is thus possible to check both the correct envelope form (generated with the contribution of the DSPM and ACM modules and, of course, of the SRFA module) and the quality of the coupling with the transmission coil (BTX). If the ratio between the two direct and reflected voltages (measurable in **<Pause>**) is less than 4 there may be a tuning problem on the transmission coil or a malfunction in the SRFA output.

<Channel> = “**4”** is used to modify the sampling frequency of the acquisition subsystem (**<Sampling rate>**). It corresponds to the time base of a regular oscilloscope and allows enlarging or reducing the RF pulse envelope.

In this case too, before displaying the two signals, click on **<Scale>**, then select the **<Dec>** mode on the y axis, so that the values on the y grid will be expressed in Volts.

- Under ARAS, select **<Test> <Trouble Shoot.> <System Check>**
- Click on channel and select the 5 channel, as shown in the next figure
- If the direct and reflected pulses are not present the ACM module does not enable the SRFA module and is probably broken
- If their ratio (Pd/Pr) is close to 1, you can locate the error by connecting a 50-Ohm load to RFOUT connector of the SRFA module:
  - ⇨If you still have Pd/Pr=1 means that the SRFA is broken
  - ⇨If you have a Pr almost equal to 0 (like in the next figure) means that the problem is after the SRFA (cable, filter panel or TX Coil)
- Check if the transmission circuits in the gantry are tuned to the correct frequency, which may be out of tune or not-adjusted. If the frequency is correct, check the tuning capacitor inside the gantry with a tester to identify any open or short circuit

Fig. 74:   Channel 4 and 5 show the direct and reflected pulses



Time
○ s   Sample ●
Sample/Div: 16
Disp: 0 ÷ 256
☐ Center Scale

Trace A
● V   Level ○
V/Div: 200m
Disp: -1000 mV ÷ 2200 mV
☑ Center Scale

Trace B
● V   Level ○
V/Div: 200m
Disp: -1000 mV ÷ 2200 mV
☑ Center Scale

Trace A:
X: 145.274
Y: 9.457 mV
Mx: 13.000
My: 1916.316 mV
Trace B:
X: 145.274
Y: -15.996 mV
Mx: 1.000
My: 0.732 mV

(x=145.274 , yA=1722.807 mV, yB=1722.807 mV)

To change the spin orientation we have to send power to the phantom or patient. The SRFA takes care to amplifier the signal received from the ACM module and sent it to the Gantry (transmission circuit).

The blue trace is the direct pulse: the energy that the SRFA is transmitting to the Gantry.

The red trace is the energy that we are losing because the Gantry is not equal to the ideal load (50 Ω). It must be lower than 20% of the direct pulse.

If the red trace is flat means that the ACM module is broken or the cable between ACM and SRFA.

If the blue trace is flat disconnect the output cable and connect a dummy plug (50 Ω) to the SRFA output: if the trace is still flat means that the SRFA is broken otherwise the Gantry or the cable are broken.

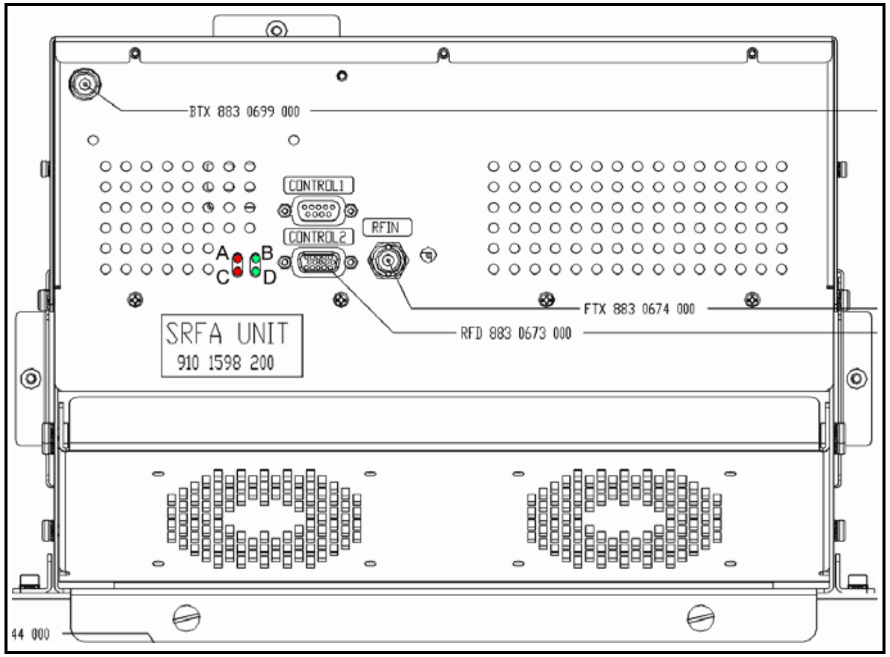
SRFA led status check

Check the SRFA functionality checking its led status meaning:

Tab. 12: SRFA led status meaning

Led	Normal	Error	Error Meaning
A	Off	On	
B	On	Off	Missing 5 V power supply inside the module
C	Off	On	Power disabled due to internal over temperature or too much direct power provided or DC power supply over thresholds
D	On/Blink	On/Off	If on when C on too: too long gate impulse or too much reflected power, if off: missing gate signal

Fig. 75: SRFA Module (inside the Electronic Unit)



Transmission Coil Check

The purpose of transmission coil calibration is to check the impedance matching to 50 Ω ± 5 Ω and the tuning to the central frequency of the magnet.

The “*Diascope*” allows the display of the “*return loss*” between the transmitted and the reflected power in dB. This waveform has a peak that must be moved to the center of the X-axis, which means that the coil is tuned to the correct frequency. Besides, it is very important to check the impedance matching to 50 Ω.

Operations:

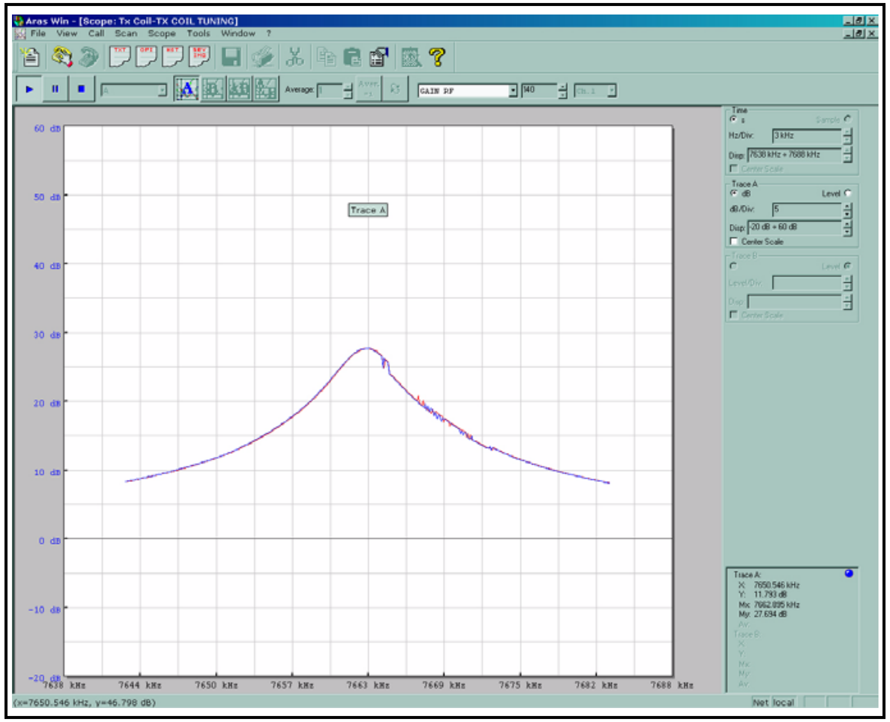
- Using the TX Coil test, check the position and the matching of the transmission pulse
- Insert the Coil 2 (Knee) with the homogeneous phantom into the magnet in axial position then Under ARAS, select **<Test> <Hardware> <TX Coil> <EXEC>**. The pulse is shown in the following figure
- Changing the channel, select the **SPAN STEP** field and set it to **100 Hz**
- Select the channel number 4 clicking on the up arrow and set the **GAIN RF** to 140. It's possible to set the **GAIN RF** from 0 (0 Watt) to 255 (900 Watt)

NOTICE	If the TX peak is not tuned to the magnet frequency it is possible that setting the gain RF to 140 causes the SRFA to go into protection mode. In this case set the gain RF after the peak adjustment

- Check if the pulse is in the central position of the screen because the magnet frequency is shown at the screen center. The maximum acceptable range is ±2.5 KHz from the central frequency. Otherwise you must adjust the tuning circuit
- Check if the highest point of the peak is at least 20 dB, otherwise you must adjust the matching circuit

The system shows all the information about the visualized pulse on the bottom right-hand corner of the screen.

Fig. 76: TX Coil Test



GAIN RF: 140

Time: Hz/Div: 3 kHz; Disp: 7638 kHz ÷ 7688 kHz

Trace A: dB; dB/Div: 5; Disp: -20 dB ÷ 60 dB; ☐ Center Scale

Trace A:
X: 7650.546 kHz
Y: 11.793 dB
Mx: 7662.895 kHz
My: 27.694 dB

(x=7650.546 kHz, y=46.798 dB)

Receiving Coils Check

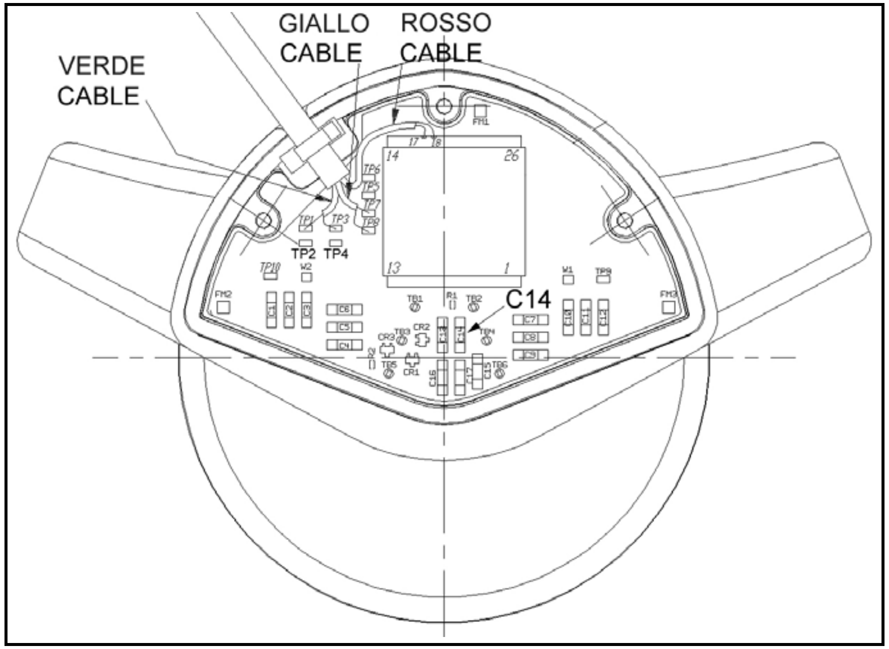
Following the transmission chain you can perform some checks directly on the coil circuits in order to test if the Varicaps and power supply voltages reach the coil.

To do this, open the coil covers to access the circuits and check the signal with a multi meter.

Coil 1 Shoulder

Remove the coil cover at the top, unscrewing the three plastic screws.

Fig. 77: Upper circuit

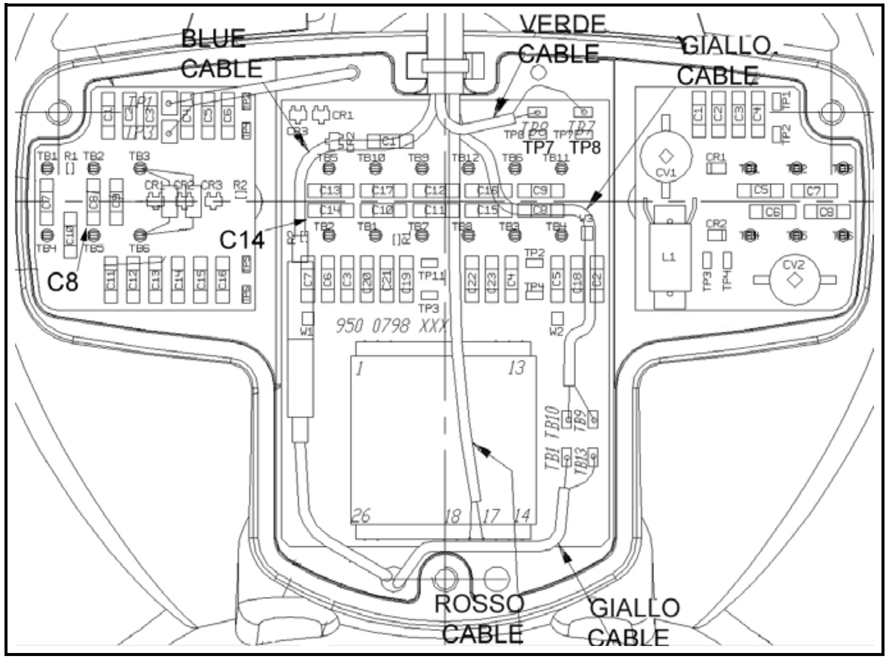


- Giallo Cable: connect the coil and measure the powers supply (15 V)
- C14: disconnect the coil and measure 0.6 V (diode voltage) using the multi meter in diode function
- Verde Cable or TP2&TP4: recognition resistor of the coil
- Rosso Cable: connect the coil, move the Varicap value by software (Under ARAS, select <Test> <Manual> <Coil tuning>)

Coil 2 Knee

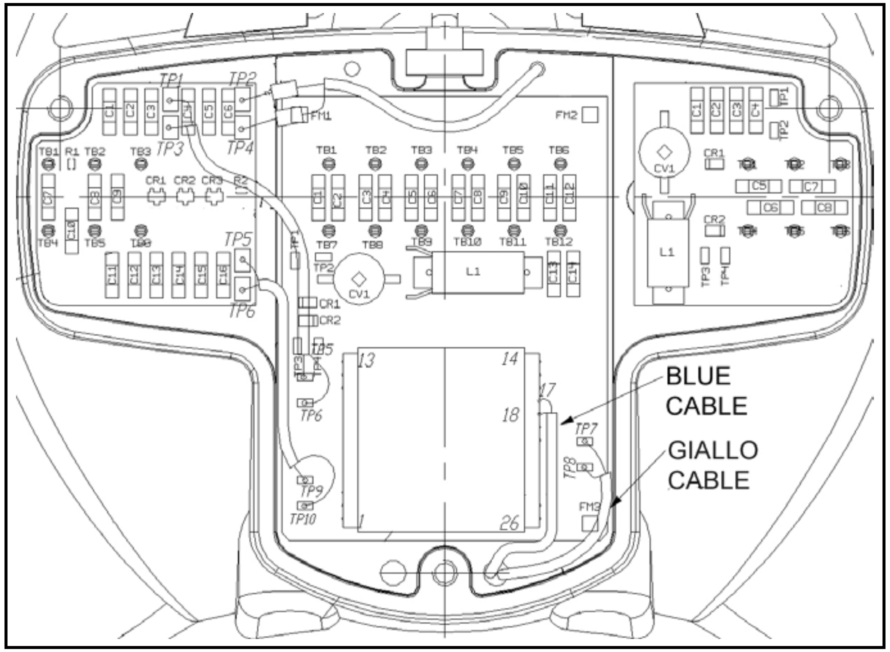
Remove the coil covers on the sides, unscrewing the three plastic screws.

Fig. 78: Coax Cable side circuits



- Blue Cable or C8: connect the coil and move the Varicap2 value by software (Under ARAS, select <Test> <Manual> <Coil tuning>); disconnect the coil and measure 0.6 V (diode voltage) using the multi meter in diode function
- C14: disconnect the coil and measure 0.6 V (diode voltage) using the multi meter in diode function
- Rosso Cable: connect the coil move the Varicap1 value by software (Under ARAS, select <Test> <Manual> <Coil tuning>)
- Giallo Cable: connect the coil and measure the powers supply (15 V)
- Verde Cable or TP7&TP8: recognition resistor of the coil

Fig. 79: No Coax Cable side circuits

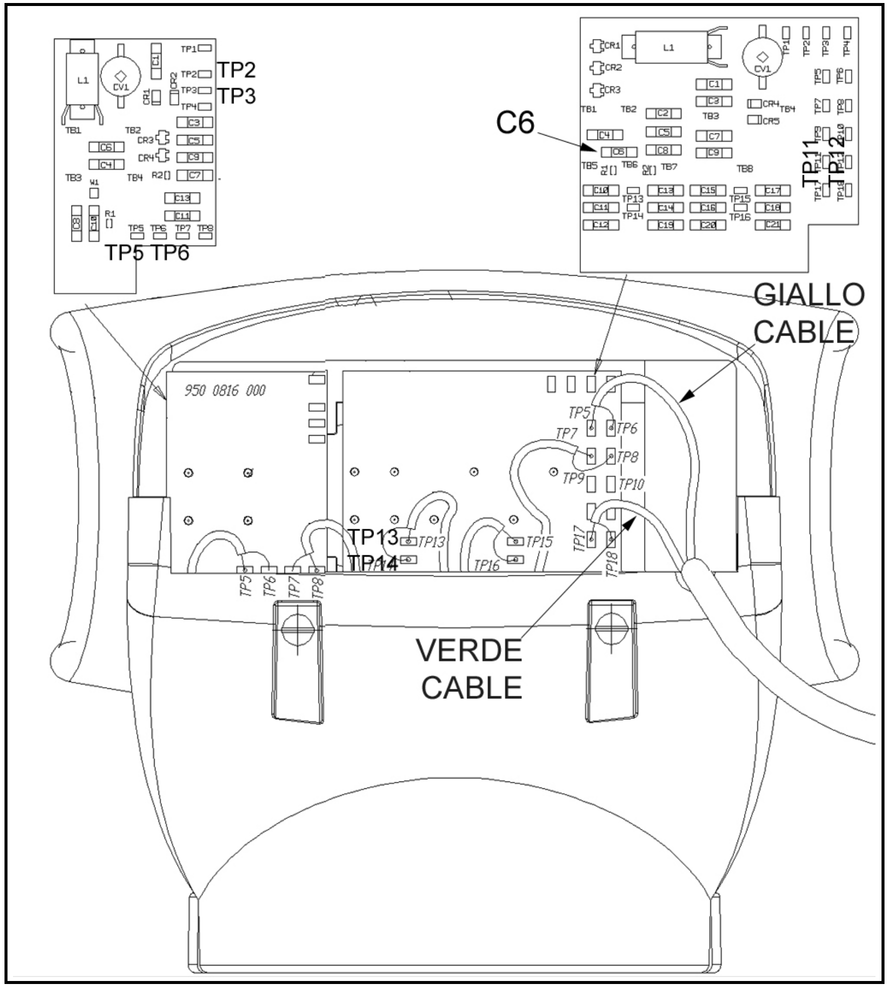


⚠WARNING **Do not remove the copper stripes or the Coil will lose the decoupling between the linear and saddle circuits**

Coil 3 Hand

Remove the coil cover on the side, unscrewing the two plastic screws.

Fig. 80: Coil 3 circuits



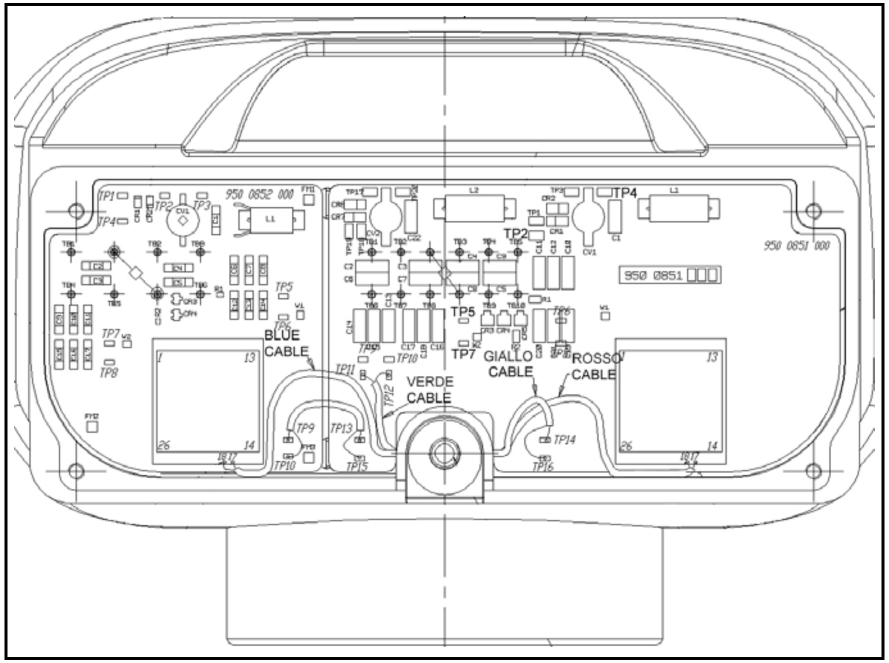
- C6: disconnect the coil and measure 0.6 V (diode voltage) using the multi meter in diode function
- TP2&TP3: disconnect the coil and measure 0.6 V (diode voltage) using the multi meter in diode function
- Giallo Cable: connect the coil and measure the powers supply (15 V)
- TP5&TP6 saddle: connect the coil move the Varicap2 value by software (Under ARAS, select <Test> <Manual> <Coil tuning>)
- Verde Cable or TP11&TP12: recognition resistor of the coil
- TP13&TP14: connect the coil move the Varicap1 value by software (Under ARAS, select <Test> <Manual> <Coil tuning>)

⚠**WARNING** **Do not remove the copper stripes or the Coil will lose the decoupling between the linear and saddle circuits**

Coil 4 Foot

Remove the coil cover on the side unscrewing the four plastic screws.

Fig. 81: Coil 4 Circuits



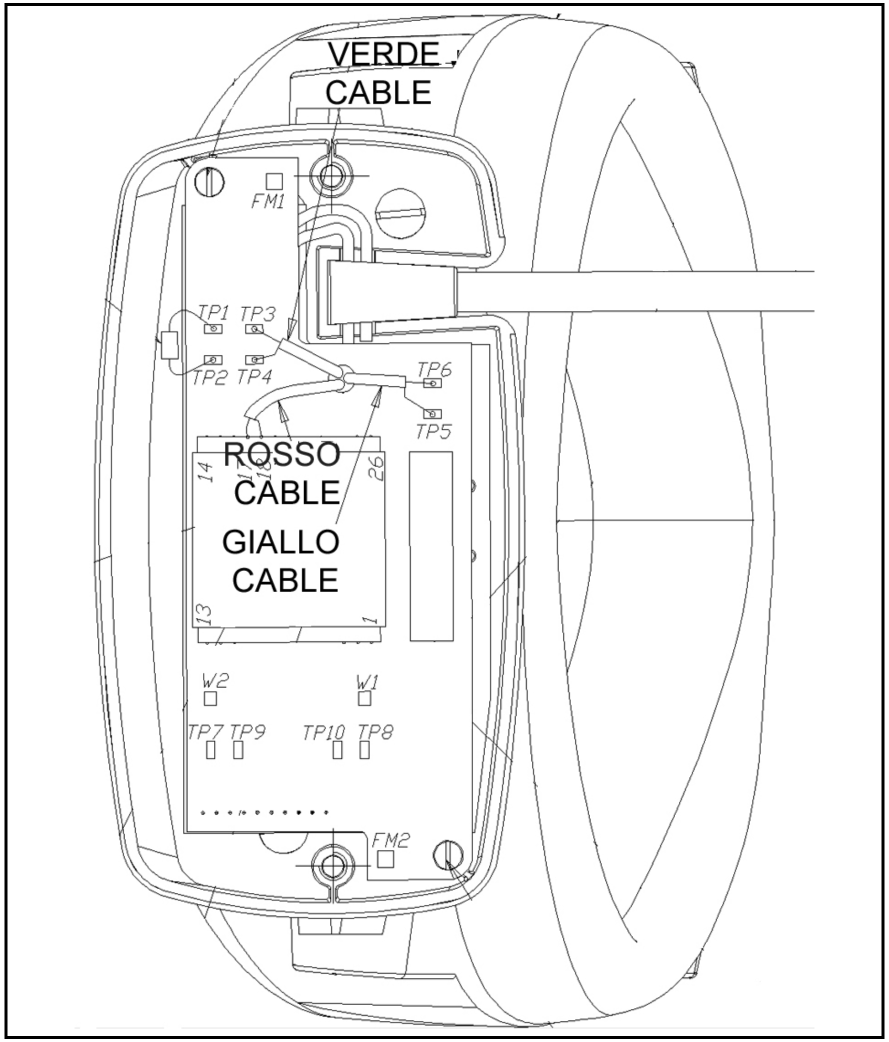
- TP5&TP2, TP7&TP4: disconnect the coil and measure 0.6 V (diode voltage) using the multi meter in diode function
- Giallo Cable or TP9&TP10: connect the coil and measure the powers supply (15 V)
- Verde Cable: recognition resistor of the coil
- Rosso Cable or TP6&TP8: connect the coil and move the Varicap1 value by software (Under ARAS, select <Test> <Manual> <Coil tuning>)
- C4: disconnect the coil and measure 0.6 V (diode voltage) using the multi meter in diode function
- Blue Cable or TP5&TP6: connect the coil and move the Varicap2 value by software (Under ARAS, select <Test> <Manual> <Coil tuning>)

⚠**WARNING** **Do not remove the copper stripes or the Coil will lose the decoupling between the linear and saddle circuits**

Coil 5 Shoulder

Remove the coil cover on the side unscrewing the four plastic screws.

Fig. 82: Upper Tuning circuit screws



- TP &TP: disconnect the coil and measure 0.6 V (diode voltage) using the multi meter in diode function
- Giallo Cable: connect the coil and measure the powers supply (15 V)
- Verde Cable or TP1&TP2: recognition resistor of the coil
- Rosso Cable: connect the coil and move the Varicap1 value by software (Under ARAS, select <Test> <Manual> <Coil tuning>)

Coil 6 Flex

Remove the coil cover on the side unscrewing the four plastic screws.

Fig. 83: Coil 6 Flex

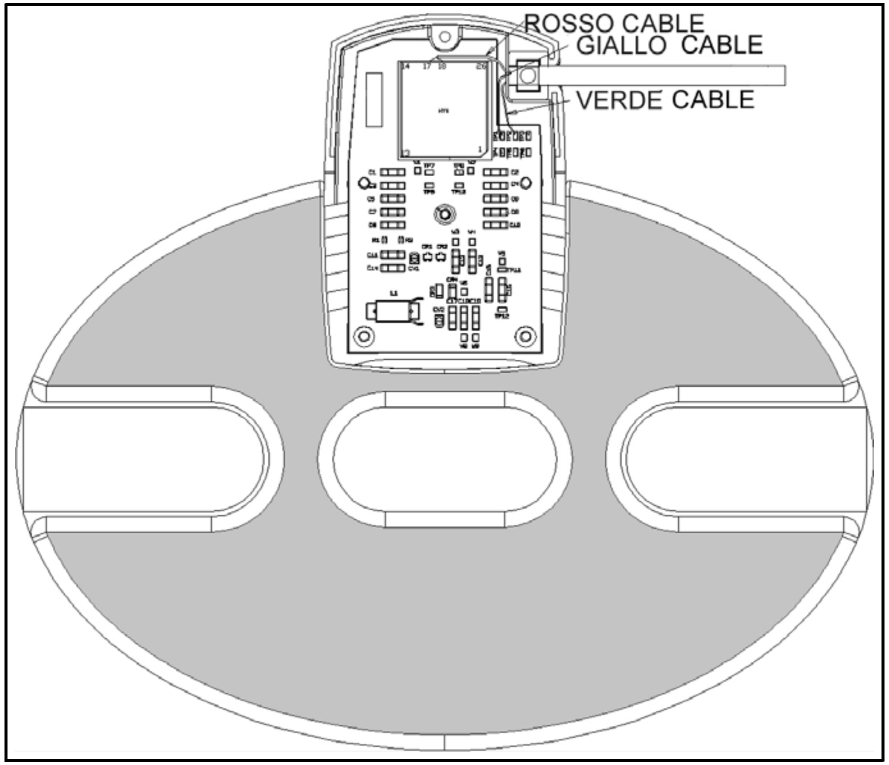
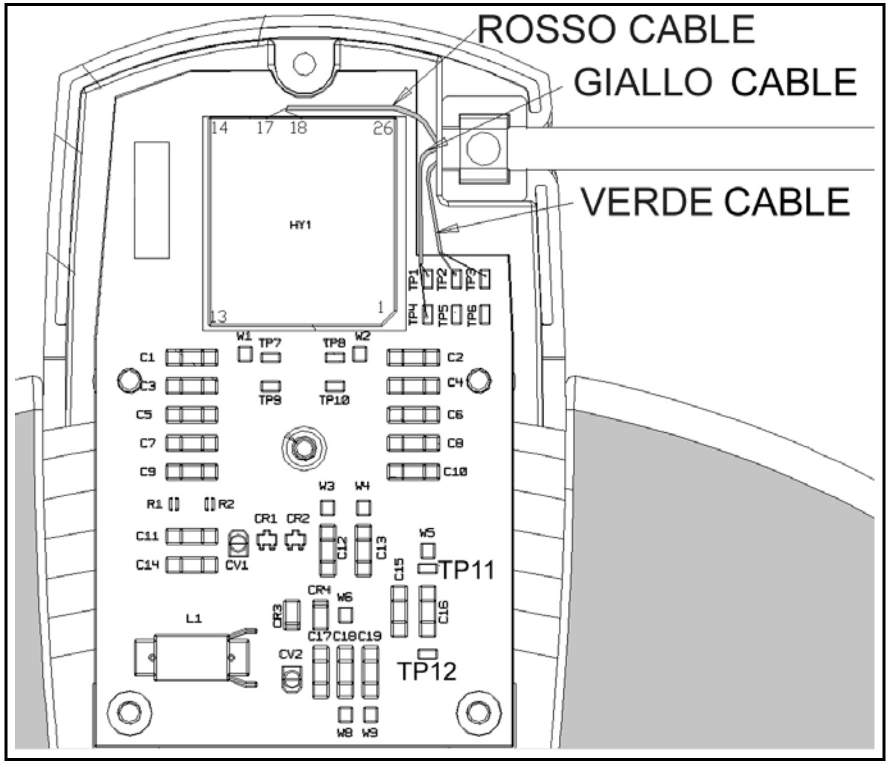


Fig. 84: Upper Tuning circuit screws



- TP11&TP12: disconnect the coil and measure 0.6 V (diode voltage) using the multi meter in diode function
- Giallo Cable: connect the coil and measure the powers supply (15 V)
- Verde Cable: recognition resistor of the coil
- Rosso Cable: connect the coil and move the Varicap1 value by software (Under ARAS, select <Test> <Manual> <Coil tuning>)

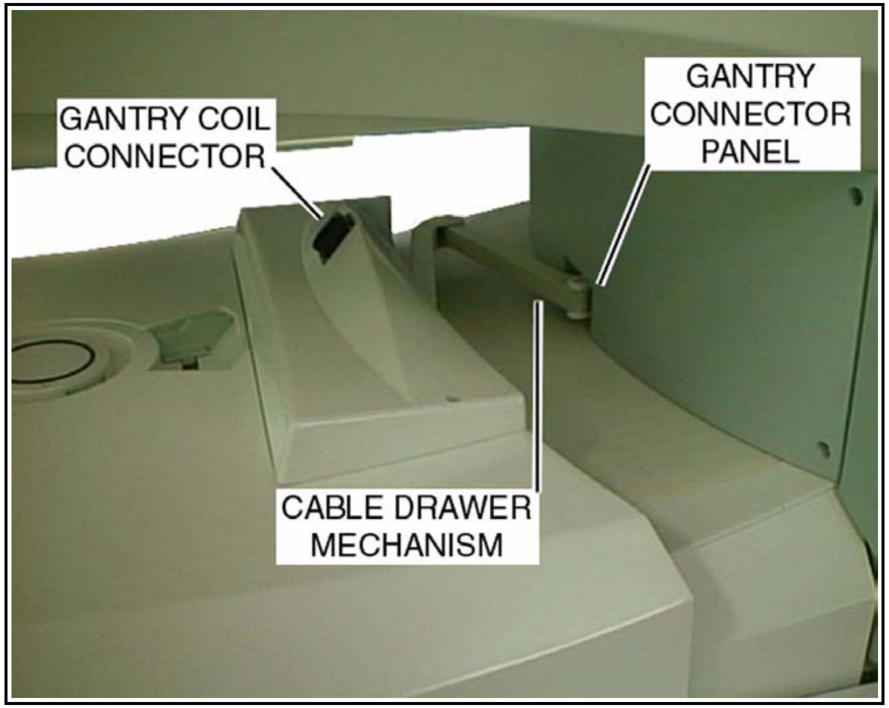
Gantry connectors

Every coil uses the same connector to receive and send information to the system; this connector is fixed to the upper patient bed cover, inside the gantry, and slides with it.

All the cables are connected to the connector panel fixed to the gantry, from this cover to the magnet. To have access to it, you must remove the transmitting circuit cover fixed to the gantry and unscrew the four screws that hold it.

In the next figures the coil connector and the gantry connector panel are shown.

Fig. 85: Receiving cables

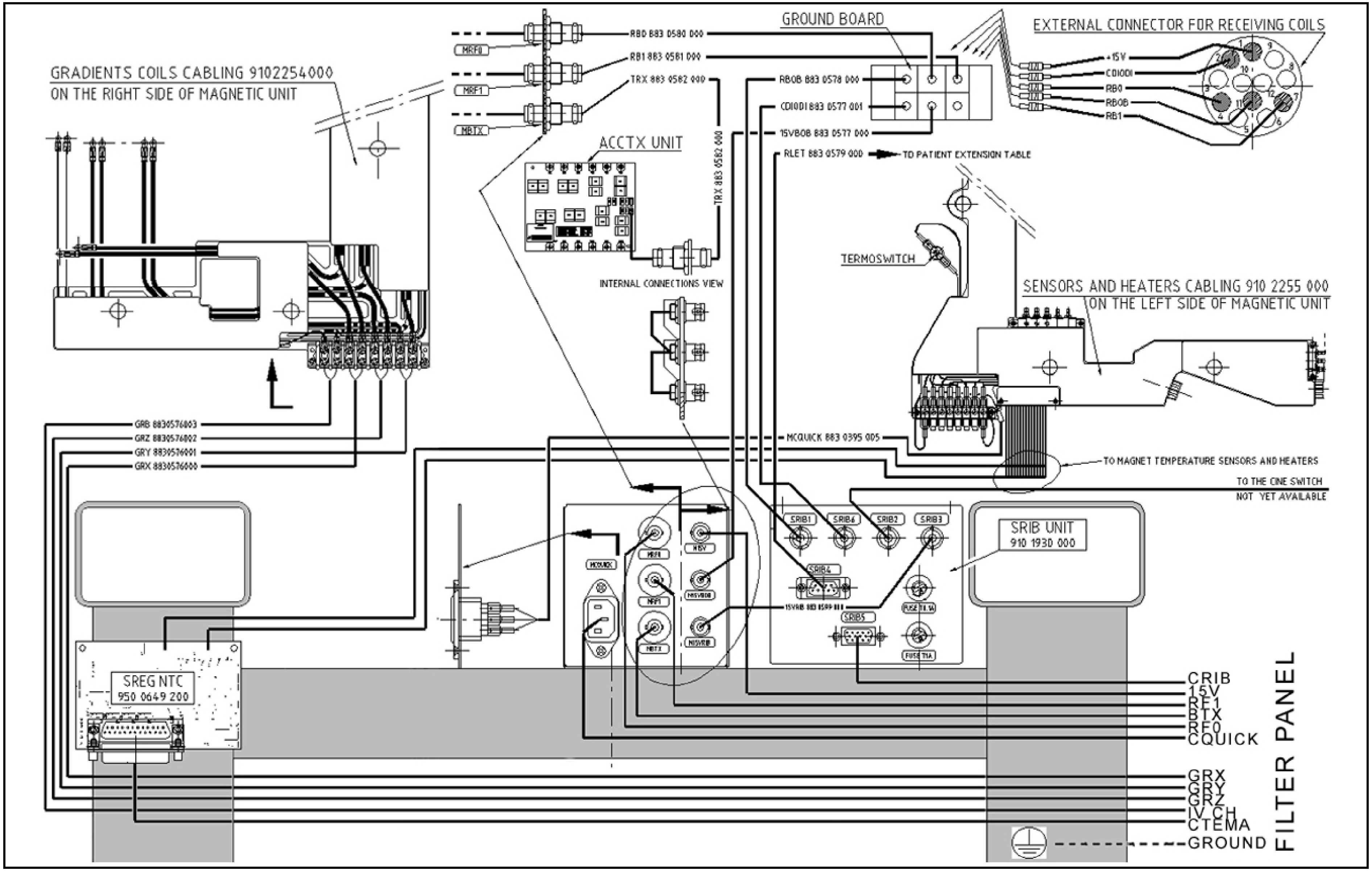


Tab. 13: Resistance coil recognition values

Coil	**Type**	**Value**
1	Shoulder	427 Ω
2	Knee	274 Ω
3	Hand/Wrist	352 Ω
4	Foot/Ankle	583 Ω
5	Shoulder	665 Ω
6	Flex	505 Ω

In the next figure the gantry connector layout and all the connection from the magnet panel and RIB module are shown.

Fig. 86: Magnet cable layout



Repair

Transmission Coil

Necessary Tools

- Non ferromagnetic screwdriver
- Kit capacitors for Transmission Coil tuning
- Soldering Machine

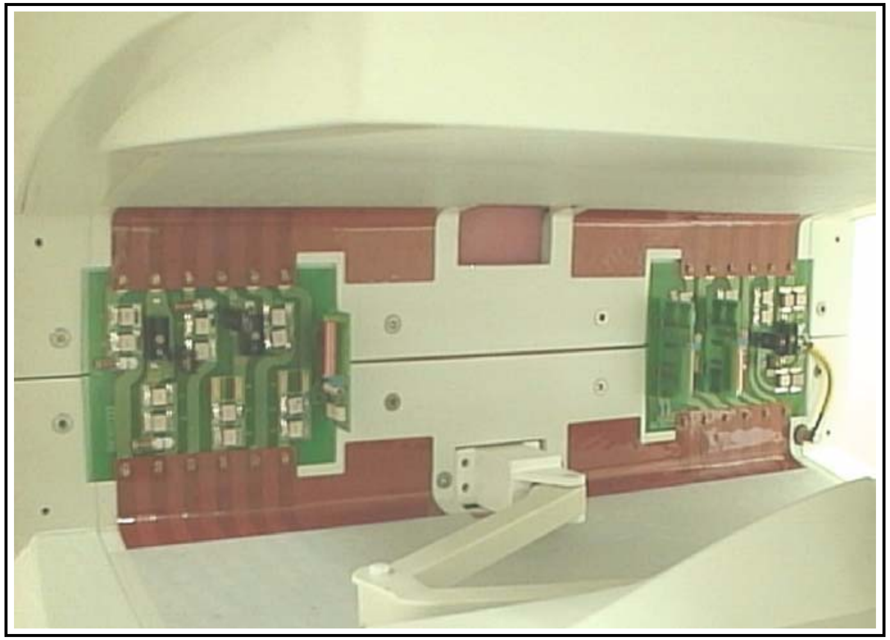
Adjustment Procedure

If the transmission peak is not correct, first of all remove the transmission circuits cover (removing the four screw in the cover corners) in order to have access to the transmission circuits.

⚠**WARNING** **Don't touch with hands the TX Coil circuit when the Gain RF is set to 140 to avoid electric shock (the sent power is very high): set it back to 40!!!**

There are two circuits for the transmission coil: the left circuit is for tuning; the right circuit for matching. The diodes present on both the circuits are for de-coupling between the transmitting and receiving coils.

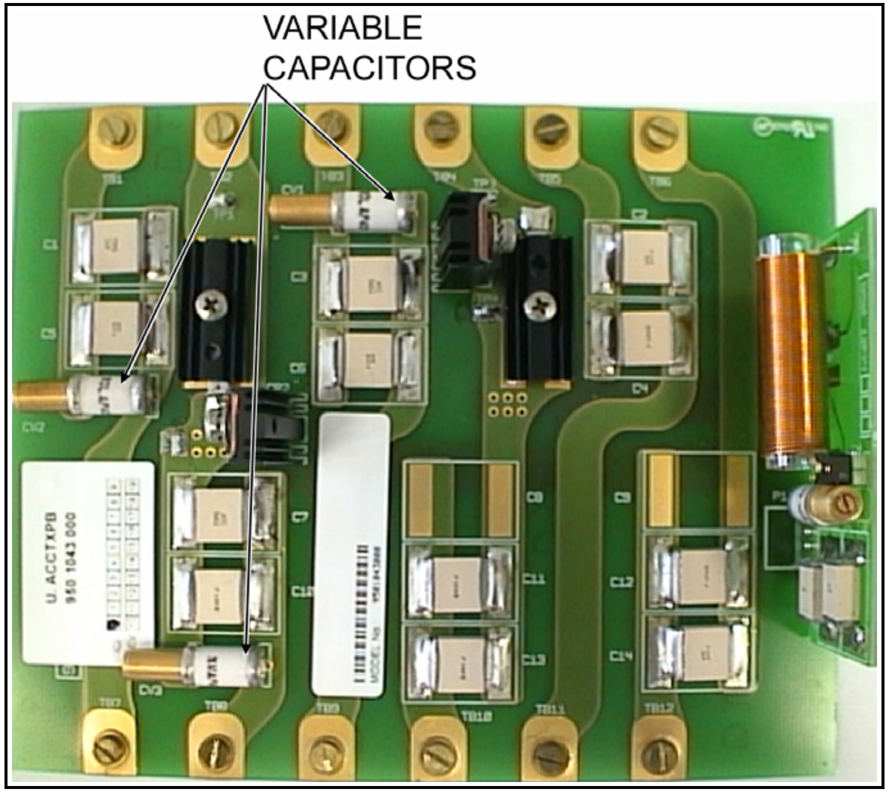
Fig. 87: Transmission circuits without cover



Tuning

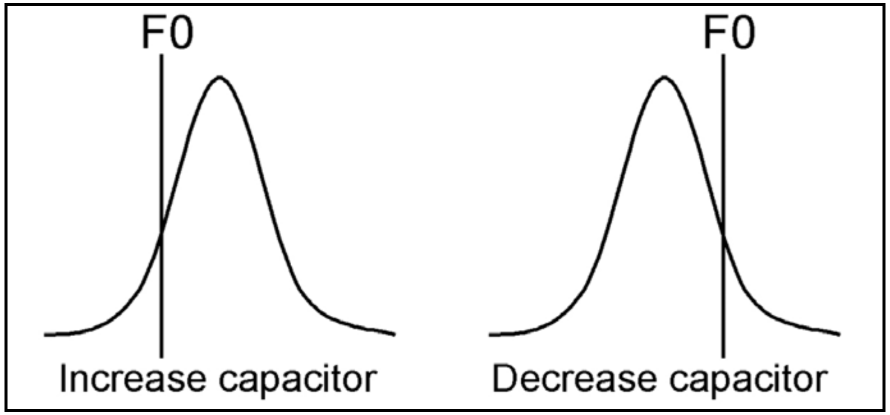
- Using the variable capacitors (20 turns) present on the tuning circuit you can move the pulse at maximum 50 KHz (f0 ± 25 KHz). The variable capacitors are shown in the following figure.

Fig. 88: Left Tuning circuit



- Turn the three variable capacitors by the same value (e.g.: two turns for each capacitor) and see directly on the monitor if you are moving the pulse in the right direction.

Fig. 89: Example of transmission peaks



- If the variable capacitors are not sufficient to reach the correct frequency you can change the value of the fixed capacitors using the criteria shown in the previous figure
- Quit the TX coil test, place the Variable Capacitor values in the middle of their characteristics turning them ten turns each one and remove one circuit from the gantry in according to the following procedure:
  - If you have to move the peak to the left, remove the **Matching Circuit** and start to decrease one of these capacitors: C2, C7, C9, C10, C11 or C12
  - If you have to move the peak to the right, remove the **Tuning Circuit**, and start to increase one of these capacitors: C2, C4, C11, C12, C13 or C14. **Never use Capacitors bigger then 390pF**

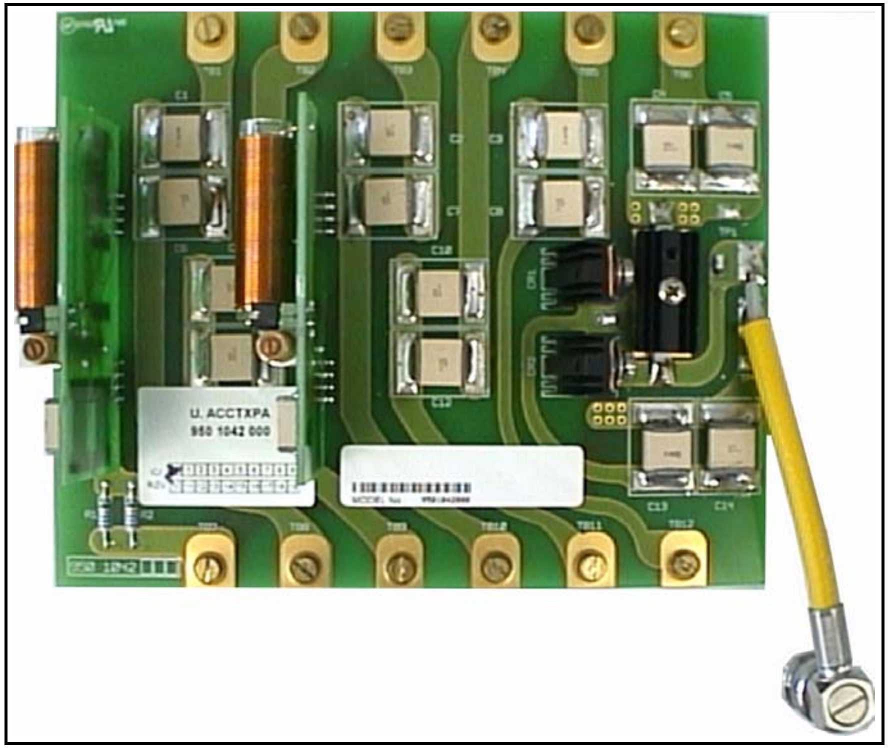
NOTICE	Verify TX peak is still in the correct position after the Cover assembling

Matching

If the pulse is lower than 20 dB you must increase the matching of the transmission coil.

In this case change the value of the fixed capacitors of the matching circuit shown in the following figure.

Fig. 90: Right Matching circuit



⚠**WARNING** **Don't touch with hands the TX Coil circuit when the Gain RF is set to 140 to avoid electric shock (the sent power is very high): set it back to 40!!!**

Touch the TX-coil with your hand close to the matching circuit to find out if you have to increase or decrease the capacitance value to obtain the correct matching value

- If the value of the matching increases you must decrease the capacitance
- If it decreases you must increase the capacitance

Decrease or increase the capacitors by a small amount, then repeat the test checking if the deepness of the peak is at least 20 dB.

Quit the TX coil test and remove the circuit from the gantry to solder other capacitors and remember that: C4+C5 = C13+C14. It means that you must change at least two capacitors at a time

NOTICE C4+C5 value must always be equal to the C13+C14 value

Repeat the test till you have the correct matching value.

NOTICE Verify that after reassembling the cover on the transmission circuits the TX peak is still in the correct position

Coil Lock

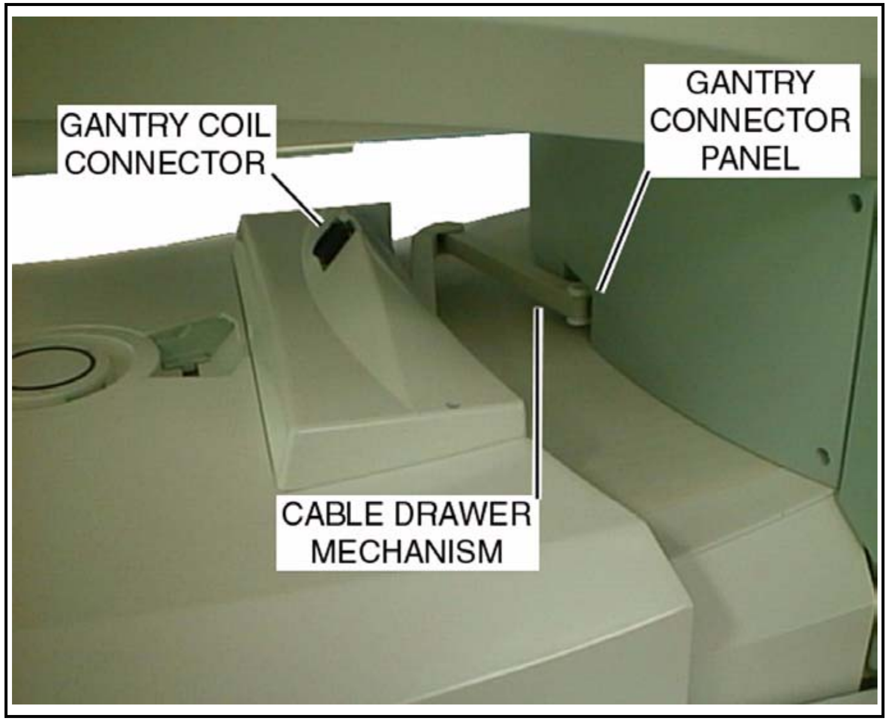
This mechanism locks the coil to the gantry during patient examination.

This mechanism allows you to rotate the coils to the best position for the patient examination.

Sequence of Operation

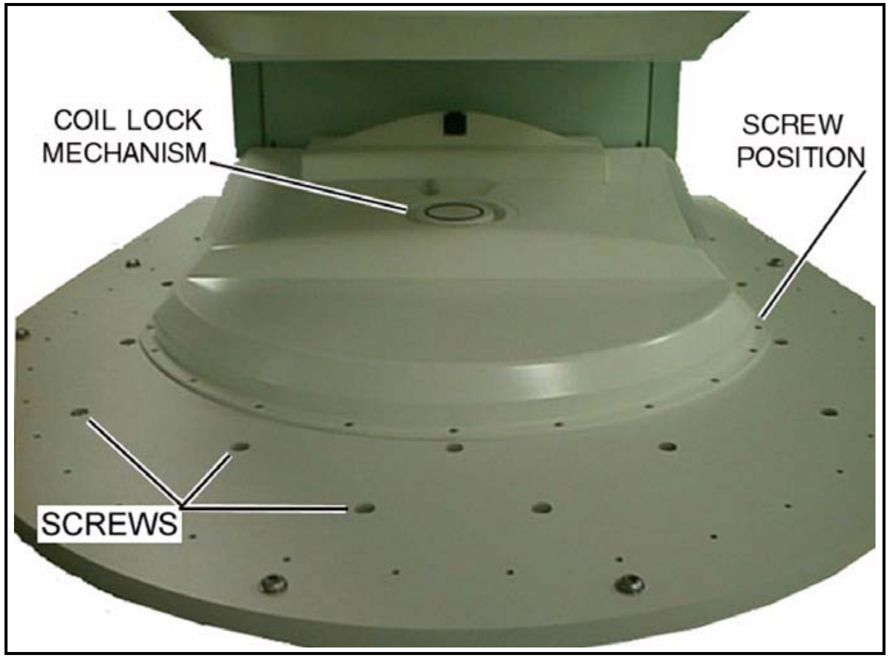
- Remove the transmission circuits cover removing the four screws placed in the cover corners

Fig. 91: Transmission circuits cover position



- Slide the patient bed a short distance out from the magnet and disconnect the cable drawer mechanism removing the four screws and disconnect the receiving cables
- Remove the white cover in which the mechanism is placed. Along the white cover edge there are screws which fix it to the round table of the patient bed, as shown in the following figure
- When the cover is removed, put the rear side in the upper position to access the mechanism and remove the three screws on it. As shown in the following figure

Fig. 92: Coil lock mechanism



- Rotate the cover again and remove the other three screws that lock the mechanism to the white cover

Fig. 93: Cover bottom view

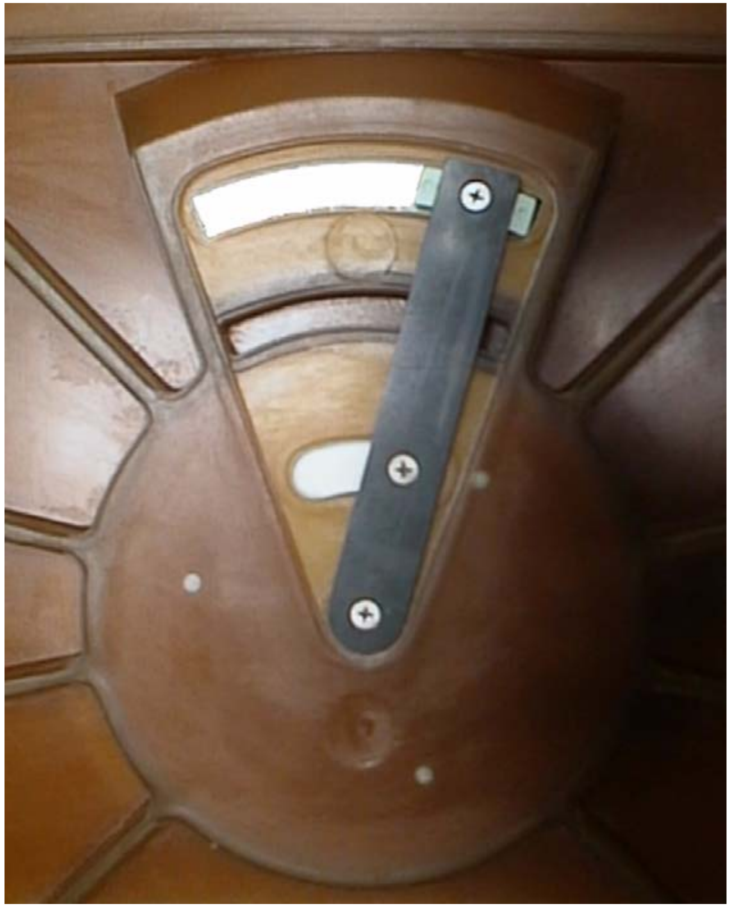
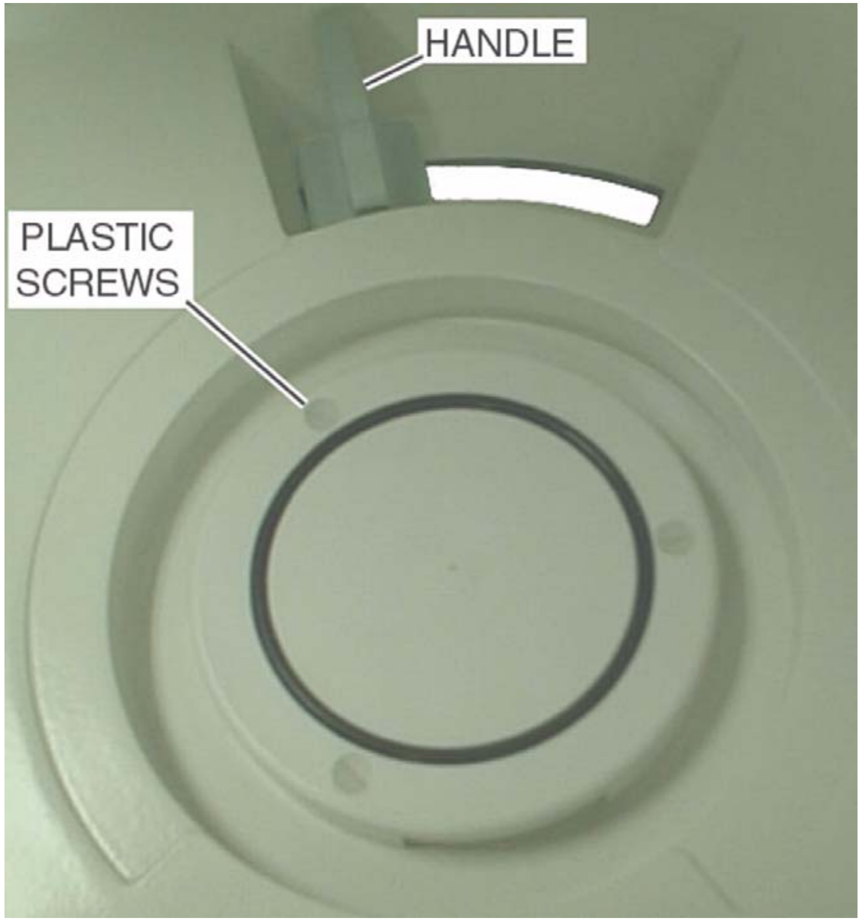
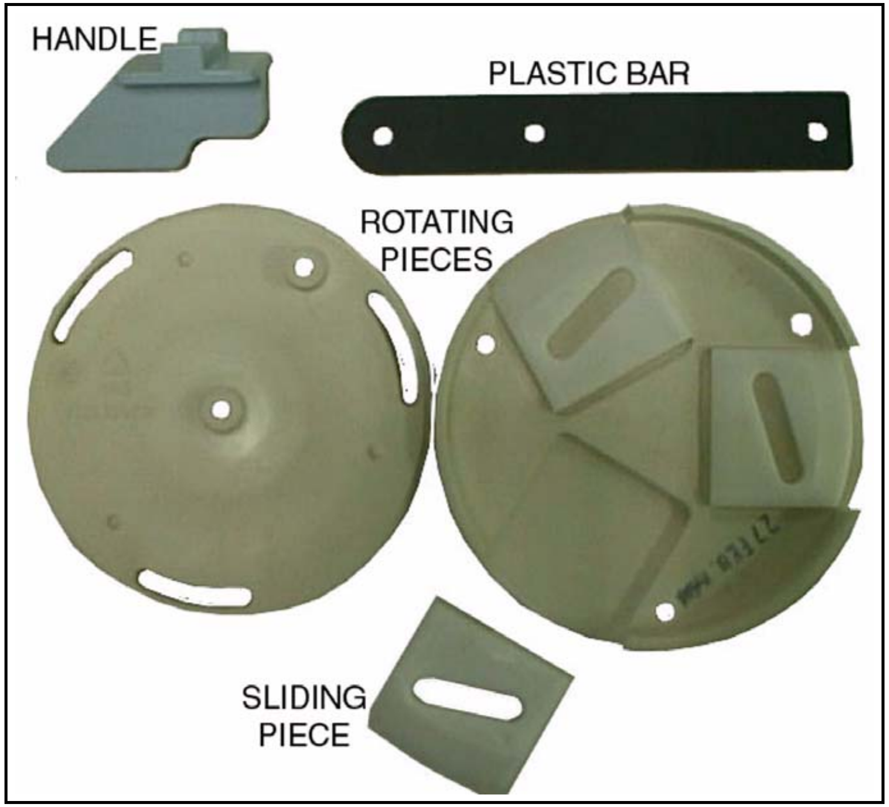


Fig. 94: Cover upper side (in the new covers the plastic screws can be stainless steel)



- Now you can remove the mechanism, screws are fitted to the center at the back: remove them to open the mechanism. The following figure shows all the parts that comprise the mechanism

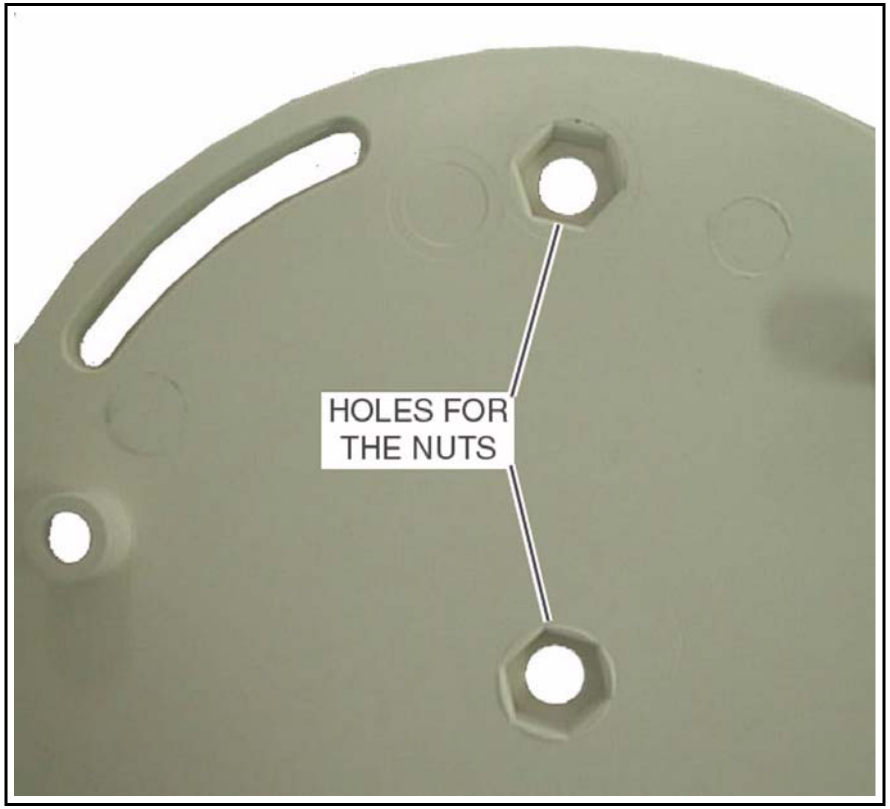
Fig. 95: Coil lock parts



In this figure you can see the handle and the plastic bar, the two circular parts (upper and lower) and the three sliding pieces.

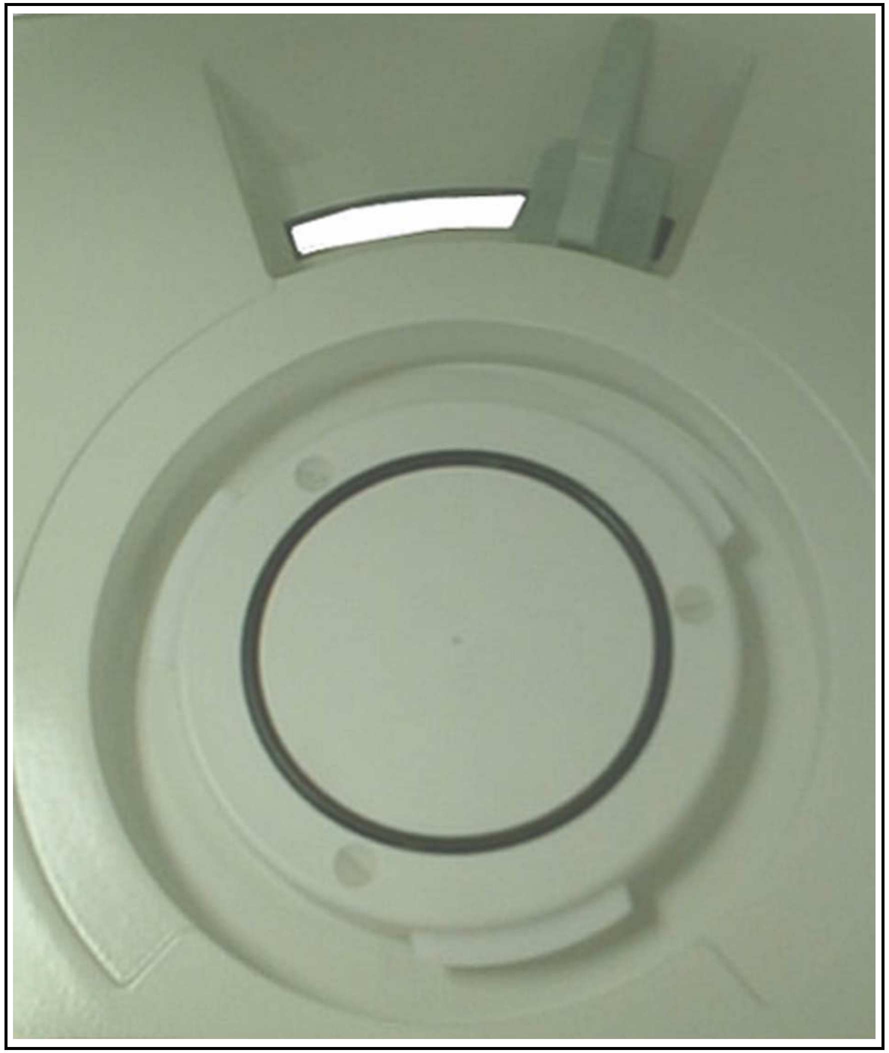
On the inside of the lower circular part there are two special holes where the nuts used to fix the plastic bar are inserted.

Fig. 96: Internal view of the circle lower part



- Now to re-install the mechanism follow the same procedure as described above and, before fixing the white cover to the round part of the patient bed, check that the mechanism works by moving the handle and checking if the sliding pieces come out to lock the coil. See the following figure.

Fig. 97: Lock mechanism in the close position



- Re-install the white coil lock cover: if the cover touches the transmission coil or if it is impossible to insert all the screws along the cover edge follow this procedure:
  - – Slightly unscrew the screws that fix the round part of the patient table to the magnet brackets (four per side) and those to the wheeled structure (five)
  - – Fix all the screws along the coil lock cover edge
  - – Tighten all the screws that fix the round part of the patient table again

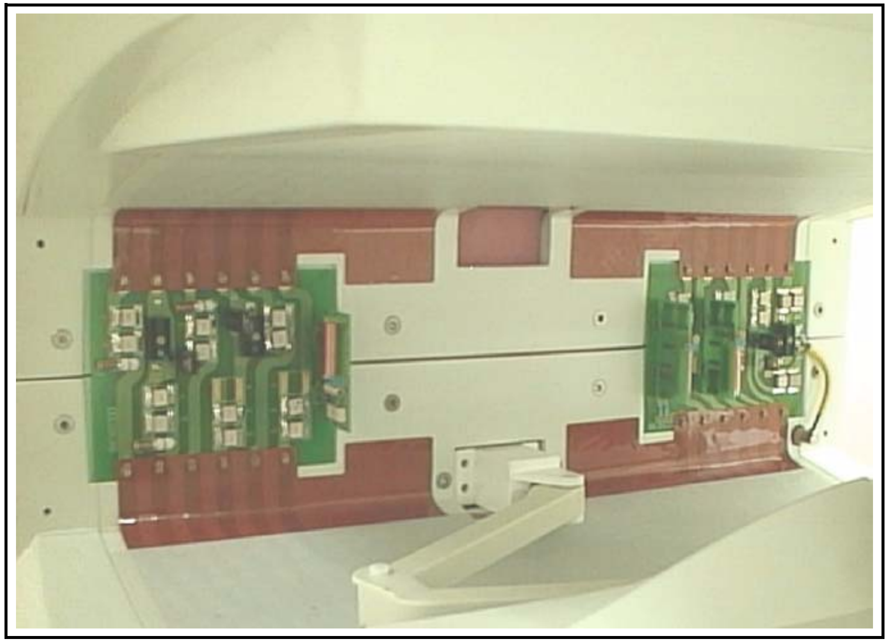
Gantry

You must remove the gantry to check or change the gradient coils or to access the shimming plates. One lower and one upper cover comprise the gantry and the transmission coil circuits which are glued to them.

Sequence operation

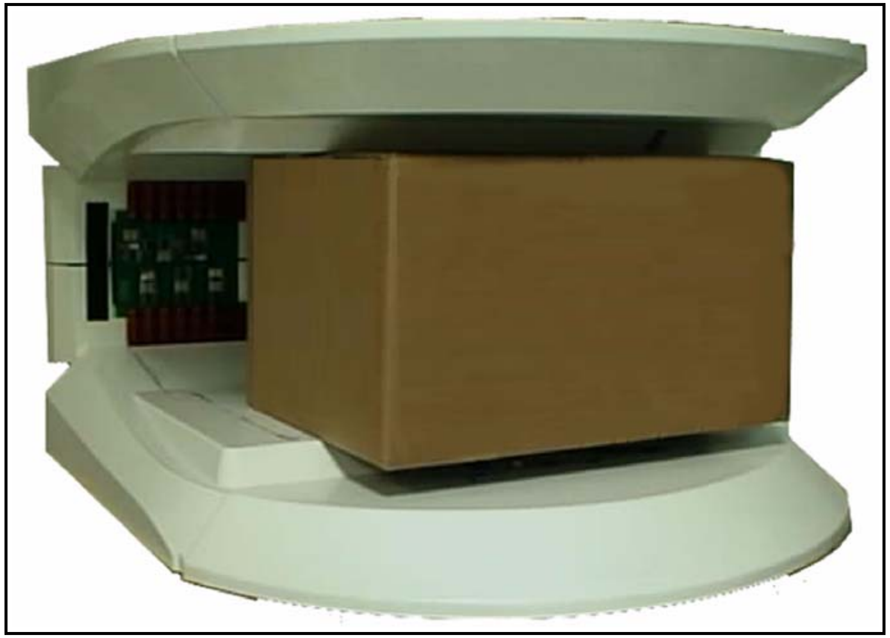
- Follow the procedure explained above for the Magnet brackets
- Now remove the rear and upper magnet covers
- Remove the tuning and matching circuits

Fig. 98: Transmitting circuits and coil



- Remove the screws on the receiving cables panel
- Remove the upper screws (four metallic and four plastic) from the upper gantry cover
- Before starting to disassemble the gantry insert something in the magnet to prevent the gantry from breaking. As written before, two covers comprise the gantry and they are joined by the aluminum plates

Fig. 99: Insert a box into the magnet to avoid gantry breaking



- The gantry is fixed to the magnet structure by screws along the upper and lower metallic profile as shown in the following figures. Using a Philips screwdriver remove the screws that fix the metallic upper profile to the magnet to remove the upper gantry cover. In the new Magnet the Gantry is fixed by clips

Fig. 100: Upper metallic profile with screws

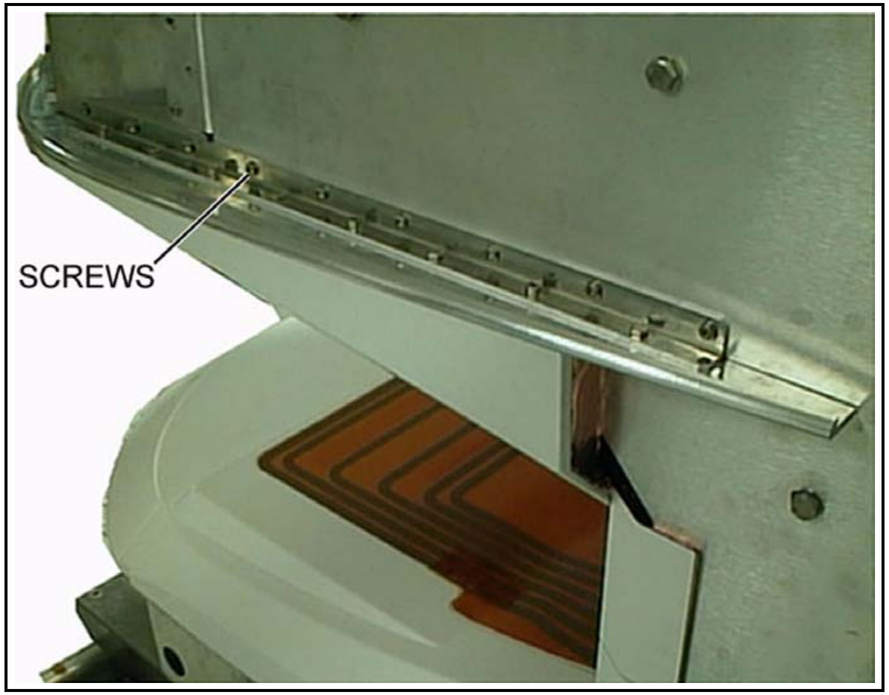


Fig. 101: Upper metallic profile with Clips

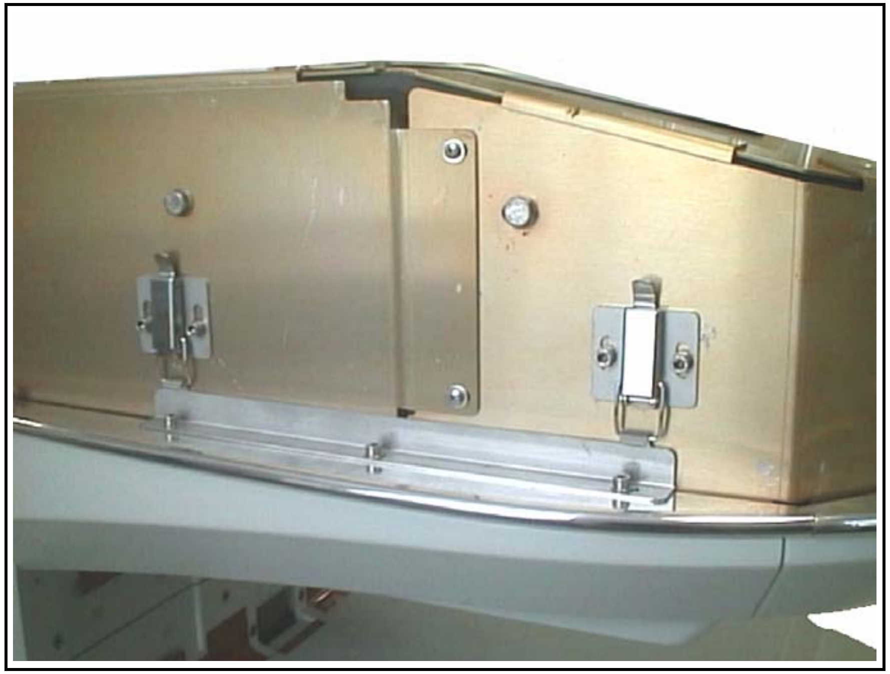
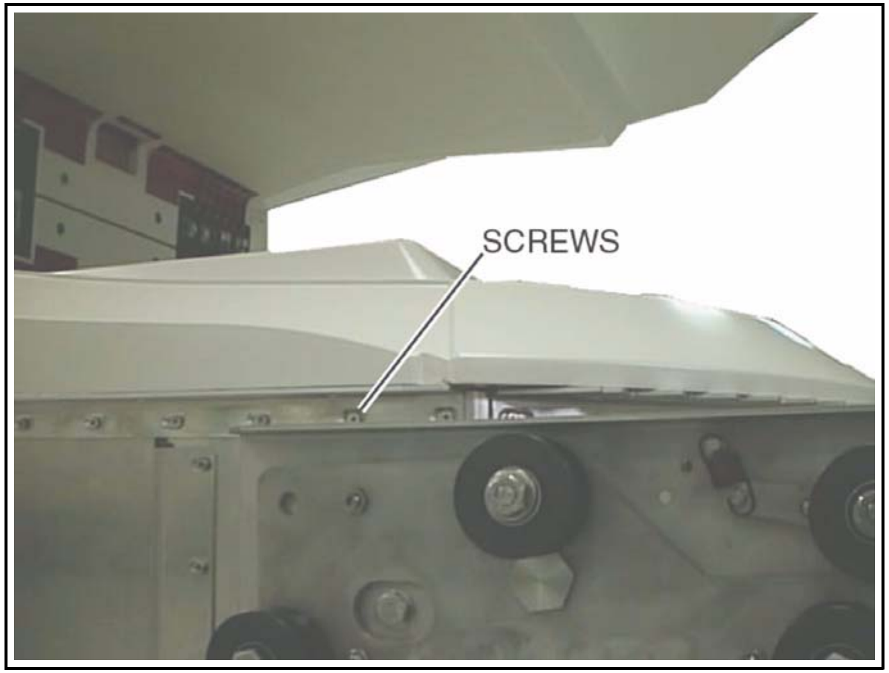
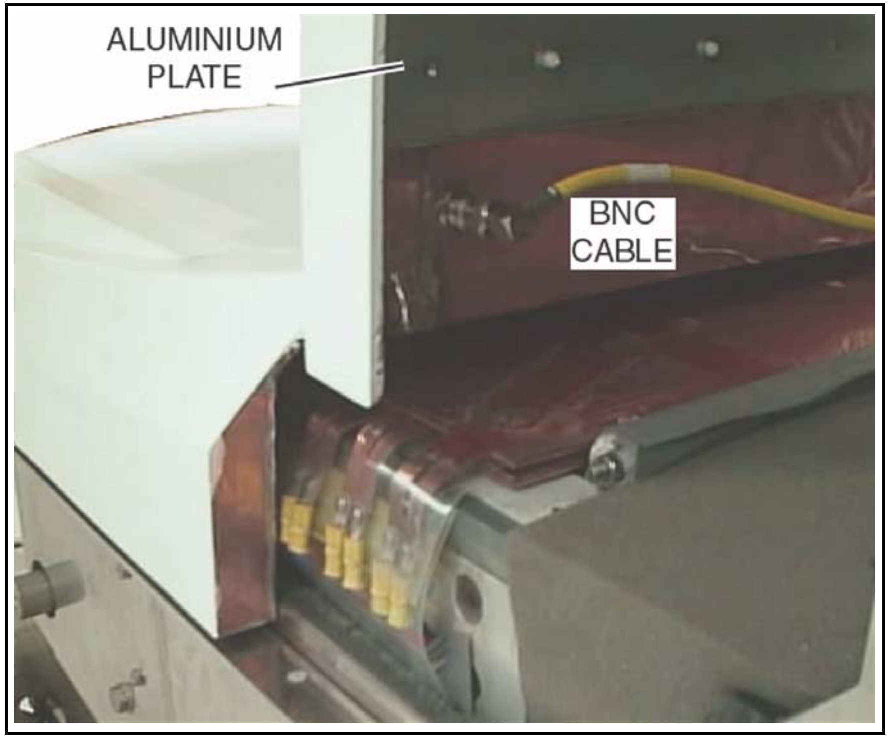


Fig. 102: Lower metallic profile with screws



- In the lower side using a Philips screwdriver, remove the screws that fix the metallic lower profile to the magnet structure and leave the lower metallic profile fixed to the gantry
- Before removing the lower gantry cover, disconnect the BNC cable connected on the back of the gantry as shown in the next figure

Fig. 103: BNC cable



- Now you can check the gradients upper and lower connection or remove the gradient coils by unscrewing the plastic screws
- Follow the procedure in reverse order to replace the gantry

Receiving coil

Introduction

This chapter describes the Service coils tuning procedure. This procedure allows the Service technician to tune the RX coil in the field, using the special capacitors kit and RX coils prepared for this purpose.

In this way time will be saved because the technician will be able to tune the coil directly on the system.

The special coils will be pre-tuned by the factory and by following the tables (each coil has a different table reporting the correct value of capacitors) the technician is able to calibrate them exactly to the frequency of the system. Each coil has a capacitors kit including different capacitor values. In the event of a coil failure the CSE is now able to tune one of the coils contained in the Service Coils kit to the correct magnet frequency and to send the broken one back.

Every coil contained in the kit is tuned at 7.65 ± 0.02 MHz. This means that if your frequency system is between 7.63 to 7.67 MHz the coils are already tuned. Otherwise look for your system frequency on the Frequency Tables to find out which capacitor values you must solder on the receiving circuit of the coils.

Necessary Tools

- Soldering
- Flat screwdriver medium tip
- Pincers
- Nippers

Tuning Procedure

- Take the same Coil that you want to replace
- The Frequency Tables (different for each coil and filled by the testing department) gives the suggested capacitors to be changed on the printed circuits of the coil, according to the band to which the frequency of the magnet belongs. These bands are 40 kHz wide. The coil is calibrated for the band centered on 7.65 MHz in the factory. You can identify PCB's by their codes. The central band (gray line) indicates the basic configuration of the coil, functioning at 7.65 MHz. If your system frequency is less than 7.63 MHz or higher than 7.67 MHz, use the Frequency Table and make sure that only capacitors to be changed are indicated: remove the original value and insert the new one or a combination. Otherwise you can expect the following cases:
  - **Signed** or **NC** cases mean “unchanged capacitor with respect to basic configuration”
  - Cases with **0** mean “remove capacitor “
  - The **sum of two capacitors** means that you are advised to insert two capacitors in parallel
  - **SMD** means use a Surface Mounted Capacitor
- Change the capacitors indicated on the Frequency Table on the printed circuits of the coil. The circuits and tables of every coil and circuit are listed below.
- Close the coil
- Insert the coil into the gantry and connect it to the system
- Perform a scout then calibrate Varicaps and 180° Pulse on the tuned coil (refer to the Installation Guide: Tune-Up chapter)
- Check if the Varicaps and 180° Pulse values are in specification (refer to the Installation Guide: Installation Protocol chapter)
- Insert the tuned coil and connect it to the system
- Place a homogeneous phantom inside the coil
- Perform a scout

- Perform a signal to noise sequence (refer to the Installation Guide, Tune-Up chapter, Signal to Noise paragraph)
- Compare the S/N value to the specification (refer to the Installation Guide: Installation Protocol chapter): if it is not correct try the calibrate Coil 180° pulse and Varicaps again
- Write down the magnet frequency on the sticker placed on the bottom of the tuned coil and erase the original coil tuning frequency

NOTICE	Unused capacitors must be shipped back, together with the broken coil, otherwise an extra amount will be charged.

NOTICE	**The following tables are just an example and for this reason are completely empty. The real tables filled with the correct Cap values are provided with the Service Coil because every Coil has its own values. Only the Tunable Flex Coil has the Caps already soldered on its circuit and is tuned to the different frequencies changing the SMS jumper settings.**

Coil 1 Shoulder

Tab. 14: PCB Code 9500793000 upper circuit table

Frequency of the magnet	C13	C14
7.51-7.55 MHz		
7.55-7.59 MHz		
7.59-7.63 MHz		
7.63-7.67 MHz		
7.67-7.71 MHz		
7.71-7.75 MHz		
7.75-7.79 MHz		

LEGEND:

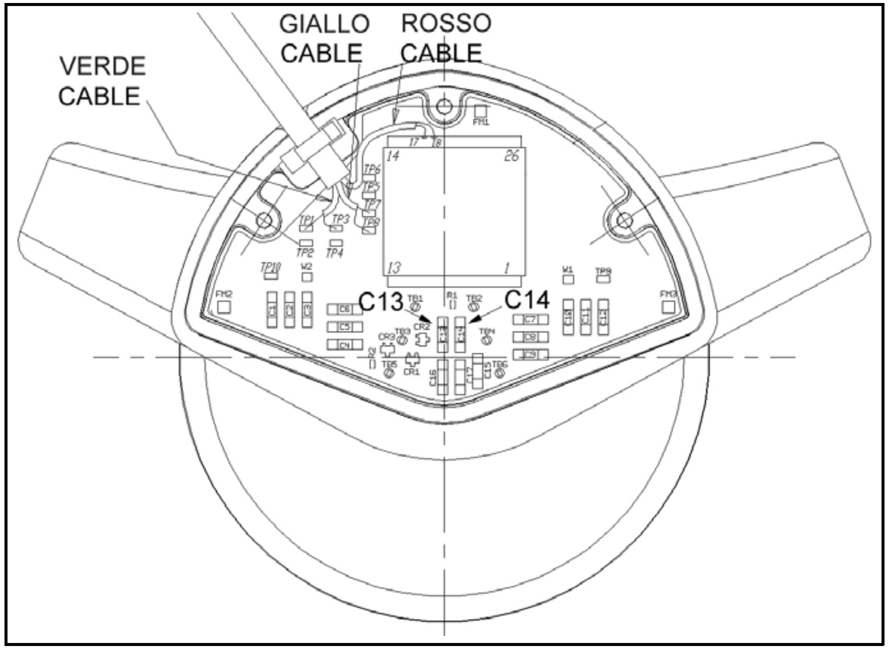
/ or **NC** = unchanged capacitor with respect to basic configuration

0 = remove capacitor

sum of two capacitors = you are advised to insert two capacitors in parallel l

SMD = use a Surface Mount capacitor

Fig. 104: Upper Shoulder Coil circuit



Tab. 15: PCB Code 9500794000 lower circuit table

Frequency of the magnet	C7	C8
7.51-7.55 MHz		
7.55-7.59 MHz		
7.59-7.63 MHz		
7.63-7.67 MHz		
7.67-7.71 MHz		
7.71-7.75 MHz		
7.75-7.79 MHz		

LEGEND:

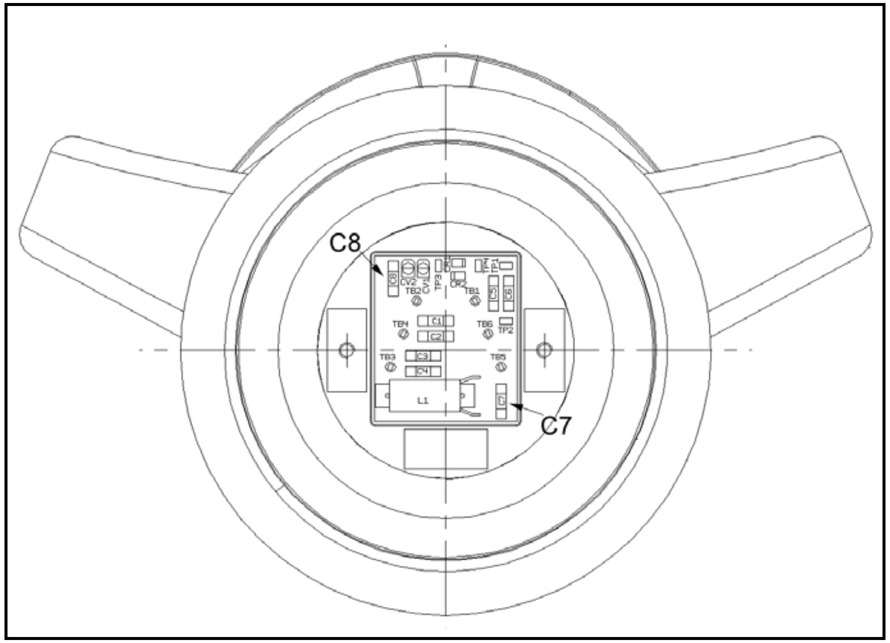
/ or **NC** = unchanged capacitor with respect to basic configuration

0 = remove capacitor

sum of two capacitors = you are advised to insert two capacitors in parallel.

SMD = use a Surface Mount capacitor

Fig. 105: Lower Shoulder Coil circuit



Coil 2 Knee

On the Coil 2 Knee there are two saddle circuits per side and two solenoid circuits placed in a vertical position between the saddle circuits. To better identify the correct coil side, this procedure is divided into a multi-coax cable side and non-multi-coax cable side.

Tab. 16: PCB Code 9500798100 solenoid circuit multi-coax cable side

Frequency of the magnet	**C13**	**C14**	**C1**	**C17**	**C12**	**C15**	**C9**
7.51-7.55 MHz							
7.55-7.59 MHz							
7.59-7.63 MHz							
7.63-7.67 MHz							
7.67-7.71 MHz							
7.71-7.75 MHz							
7.75-7.79 MHz							

LEGEND:

/ or **NC** = unchanged capacitor with respect to basic configuration

0 = remove capacitor

sum of two capacitors = you are advised to insert two capacitors in parallel

SMD = use a Surface Mount capacitor

Tab. 17: PCB Code 9500800300 left saddle circuit multi-coax cable side

Frequency of the magnet	**C9**
7.51-7.55 MHz	
7.55-7.59 MHz	
7.59-7.63 MHz	
7.63-7.67 MHz	
7.67-7.71 MHz	
7.71-7.75 MHz	
7.75-7.79 MHz	

Tab. 18: PCB Code 9500801300 right saddle circuit multi-coax cable side

Frequency of the magnet	**C1**	**C2**	**C5**
7.51-7.55 MHz			
7.55-7.59 MHz			
7.59-7.63 MHz			
7.63-7.67 MHz			
7.67-7.71 MHz			
7.71-7.75 MHz			
7.75-7.79 MHz			

LEGENDA:

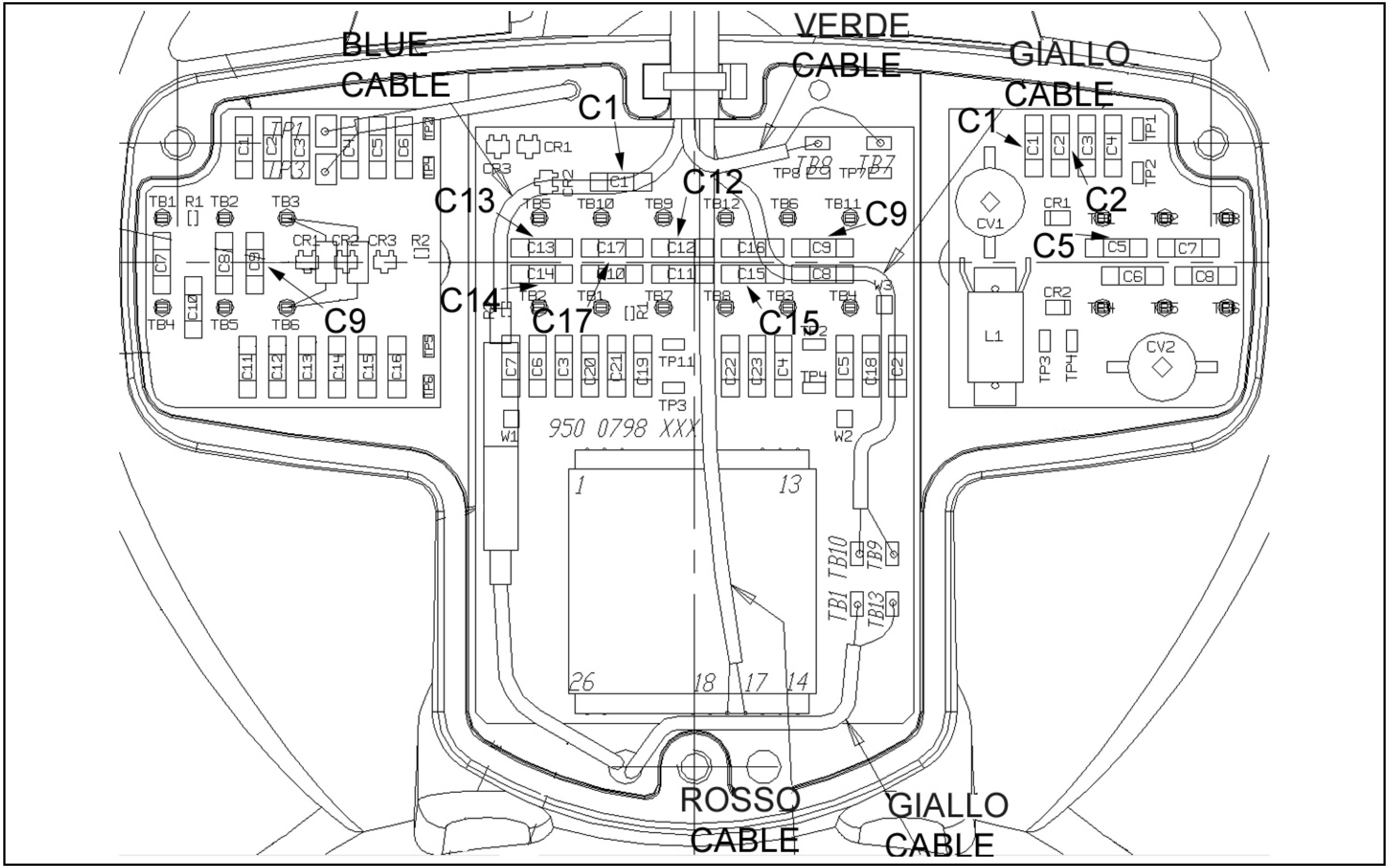
/ or **NC** = unchanged capacitor with respect to basic configuration

0 = remove capacitor

sum of two capacitors = you are advised to insert two capacitors in parallel

SMD = use a Surface Mount capacitor

Fig. 106: Knee Coil 2 Coax Cable Side



Tab. 19: PCB Code 9500799000 solenoid circuit no multi-coax cable side

Frequency of the magnet	C13	C14
7.51-7.55 MHz		
7.55-7.59 MHz		
7.59-7.63 MHz		
7.63-7.67 MHz		
7.67-7.71 MHz		
7.71-7.75 MHz		
7.75-7.79 MHz		

LEGEND:

/ or **NC** = unchanged capacitor with respect to basic configuration

0 = remove capacitor

sum of two capacitors = you are advised to insert two capacitors in parallel

SMD = use a Surface Mount capacitor

Tab. 20: PCB Code 9500800200 left saddle circuit no multi-coax cable side

Frequency of the magnet	C9	C4+C6	C14+C16
7.51-7.55 MHz			
7.55-7.59 MHz			
7.59-7.63 MHz			
7.63-7.67 MHz			
7.67-7.71 MHz			
7.71-7.75 MHz			
7.75-7.79 MHz			

LEGEND:

/ or **NC** = unchanged capacitor with respect to basic configuration

0 = remove capacitor

sum of two capacitors = you are advised to insert two capacitors in parallel

SMD = use a Surface Mount capacitor

Tab. 21: PCB Code 9500801200 right saddle circuit multi-coax cable side

Frequency of the magnet	C1	C2	C5
7.51-7.55 MHz			
7.55-7.59 MHz			
7.59-7.63 MHz			
7.63-7.67 MHz			
7.67-7.71 MHz			
7.71-7.75 MHz			
7.75-7.79 MHz			

LEGEND:

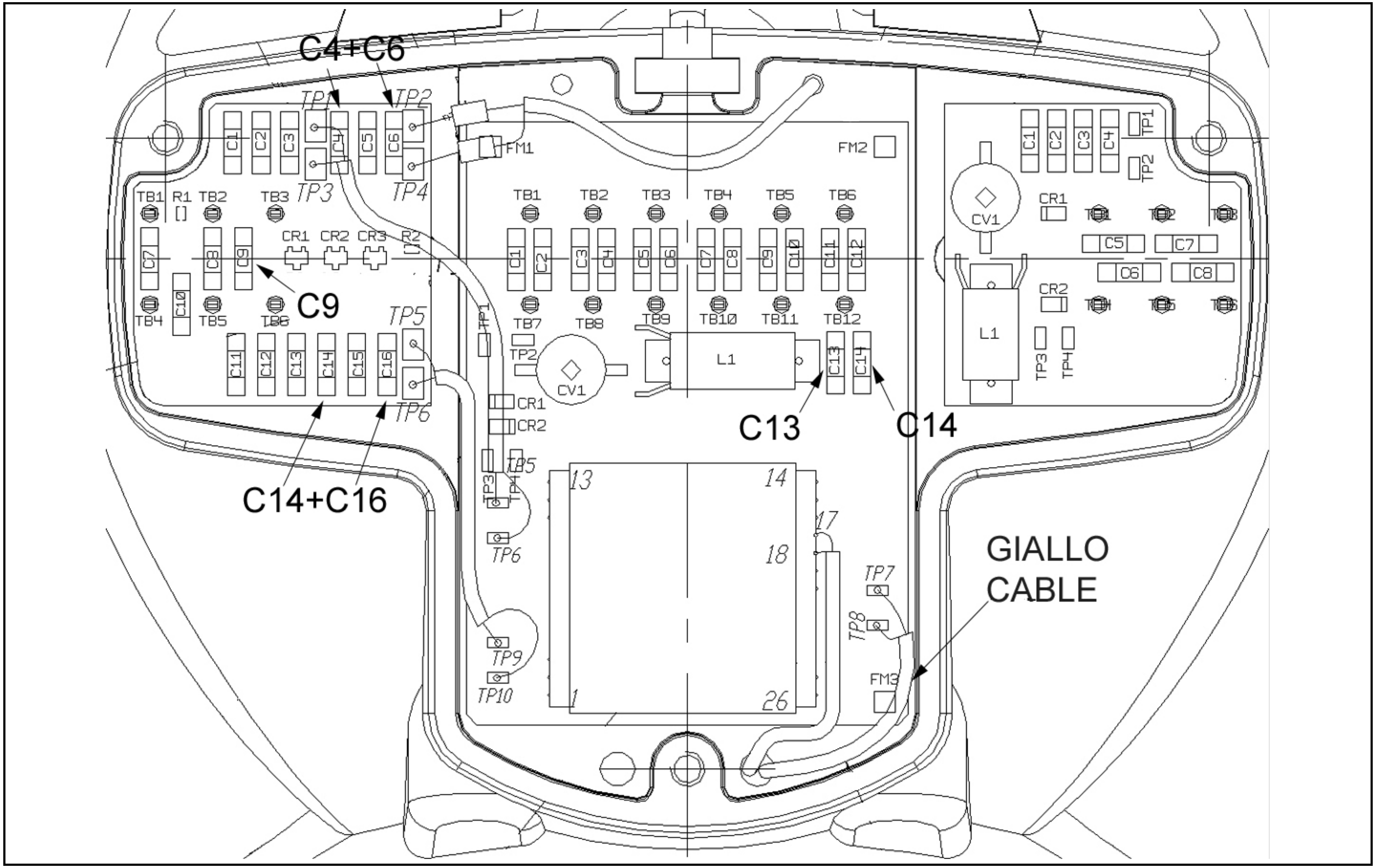
/ or **NC** = unchanged capacitor with respect to basic configuration

0 = remove capacitor

sum of two capacitors = you are advised to insert two capacitors in parallel

SMD = use a Surface Mount capacitor

Fig. 107: Knee Coil 2 No Coax Cable Side



Coil 3 wrist

Tab. 22: PCB Code 9500798100 Wrist solenoid circuit (right one)

Frequency of the magnet	C4	C6	C2	C5	C8	C1	C3
7.51-7.55 MHz							
7.55-7.59 MHz							
7.59-7.63 MHz							
7.63-7.67 MHz							
7.67-7.71 MHz							
7.71-7.75 MHz							
7.75-7.79 MHz							

Tab. 23: PCB Code 9500816000 Wrist saddle circuit (left one)

Magnet frequency	C6	C1	C4
7.51-7.55 MHz			
7.55-7.59 MHz			
7.59-7.63 MHz			
7.63-7.67 MHz			
7.67-7.71 MHz			
7.71-7.75 MHz			
7.75-7.79 MHz			

LEGEND:

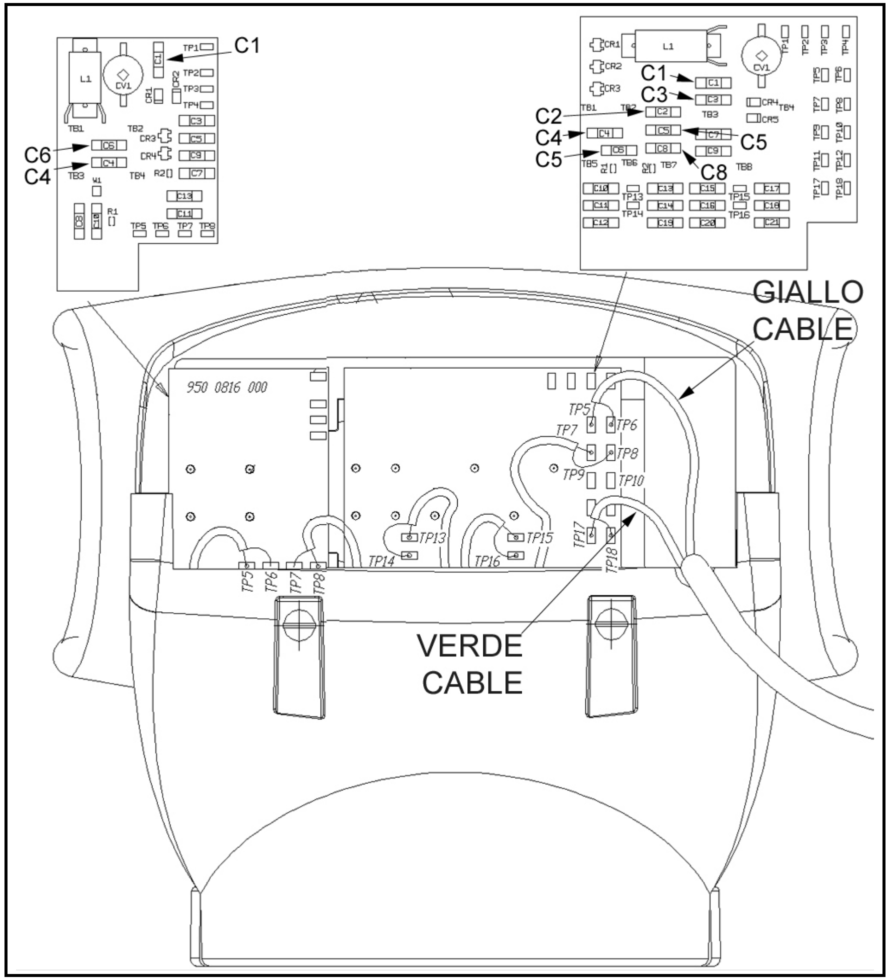
/ or **NC** = unchanged capacitor with respect to basic configuration

0 = remove capacitor

sum of two capacitors = you are advised to insert two capacitors in parallel

SMD = use a Surface Mount capacitor

Fig. 108: Wrist Coil 3



Coil 4 Ankle

Tab. 24: PCB Code 9500851000 Ankle solenoid circuit (right one)

Frequency of the magnet	C6	C7	C1	C22	c9
7.51-7.55 MHz					
7.55-7.59 MHz					
7.59-7.63 MHz					
7.63-7.67 MHz					
7.67-7.71 MHz					
7.71-7.75 MHz					
7.75-7.79 MHz					

LEGEND:

/ or **NC** = unchanged capacitor with respect to basic configuration

0 = remove capacitor

sum of two capacitors = you are advised to insert two capacitors in parallel

SMD = use a Surface Mount capacitor

Tab. 25: PCB Code 9500852000 Ankle saddle circuit (left one)

Frequency of the magnet	C4	C5	C3	C2	C1
7.51-7.55 MHz					
7.55-7.59 MHz					
7.59-7.63 MHz					
7.63-7.67 MHz					
7.67-7.71 MHz					
7.71-7.75 MHz					
7.75-7.79 MHz					

LEGEND:

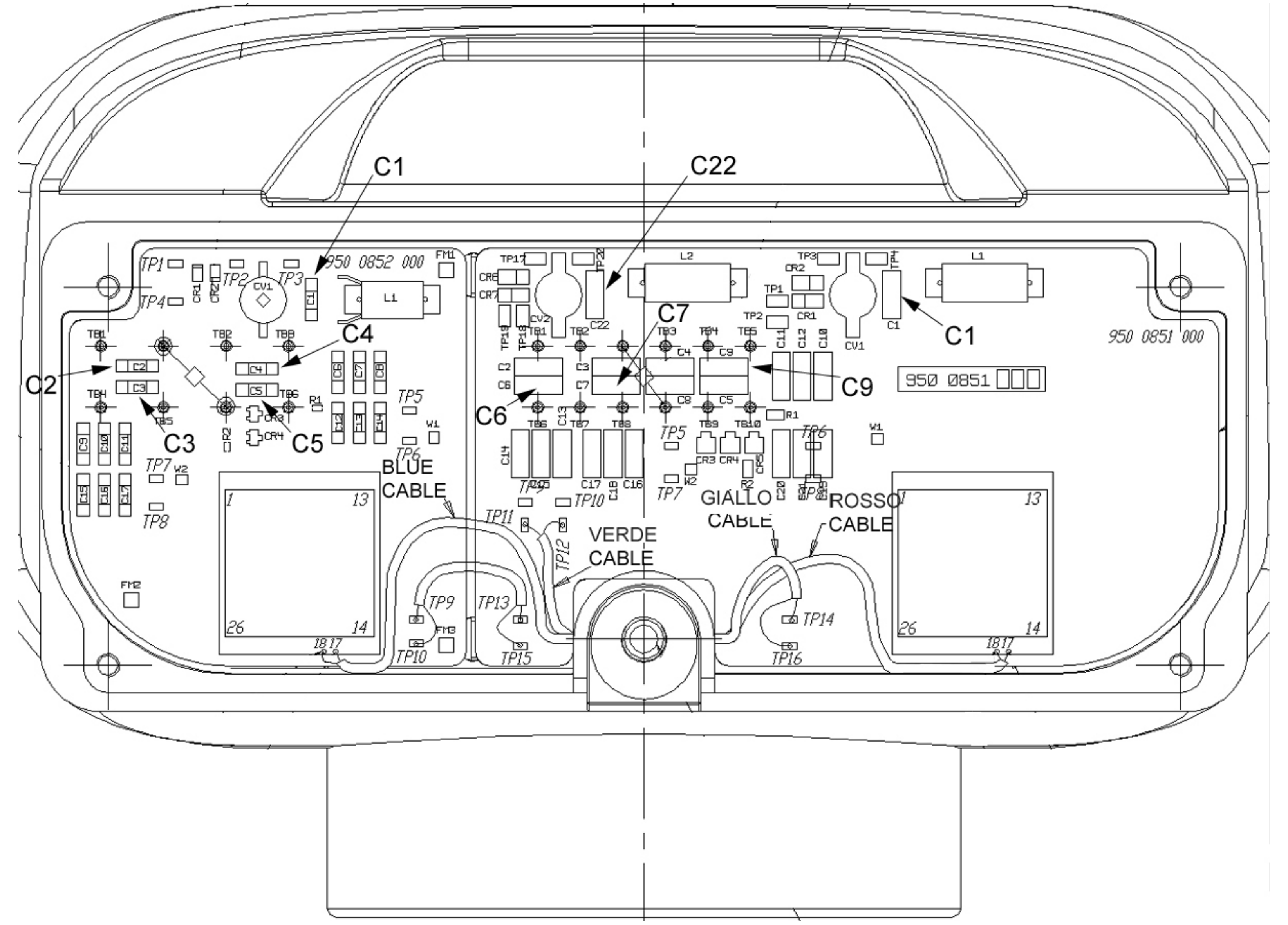
/ or **NC** = unchanged capacitor with respect to basic configuration

0 = remove capacitor

sum of two capacitors = you are advised to insert two capacitors in parallel

SMD = use a Surface Mount capacitor

Fig. 109: Ankle Coil 4



Coil 5 Shoulder

- The Service Coil 5 is tuned at 7.65 MHz: if the Magnet frequency is between 7.6 and 7.7 MHz go directly to the next paragraph Coil Calibration; if the magnet frequency is over the range 7.6 ÷ 7.7 MHz go ahead the procedure
- Open the lateral cover to gain access to the Tuning circuits and remove the upper Tuning circuit
- Find the Magnet frequency in the following table:

Tab. 26: Coil settings

Frequency of the magnet	**W2**	**W3**	**W4**	**W5**
7.5-7.6 MHz	closed	closed	closed	closed
7.6-7.6 MHz	*closed*	*open*	*open*	*closed*
7.7-7.8 MHz	open	open	open	open

Legend: Closed = leave or sold the SMD Jumper; Open = un-sold the SMD Jumper

- Identify the Jumpers on the Tuning circuit and set the Coil in according to the Magnet frequency and to the previous table

Fig. 110: Shoulder Coil 5 Upper Circuit

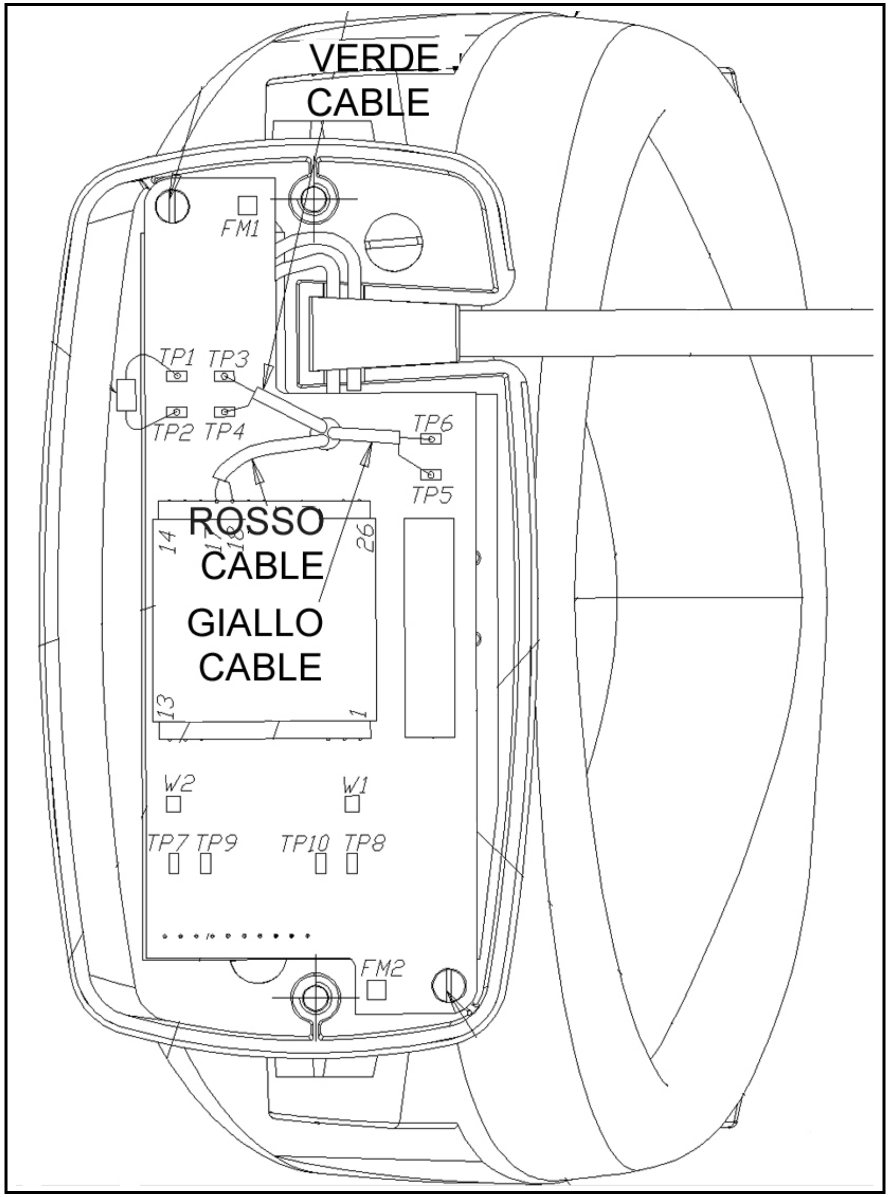
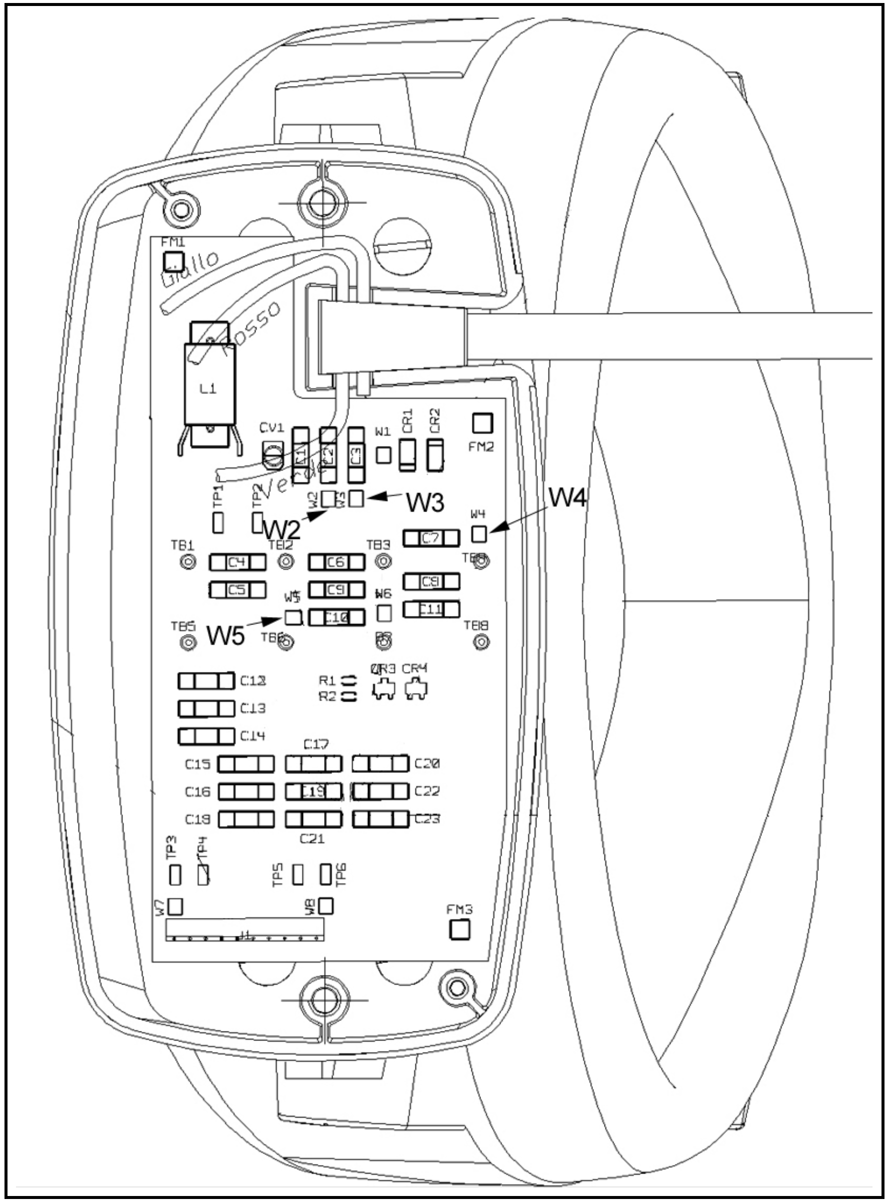


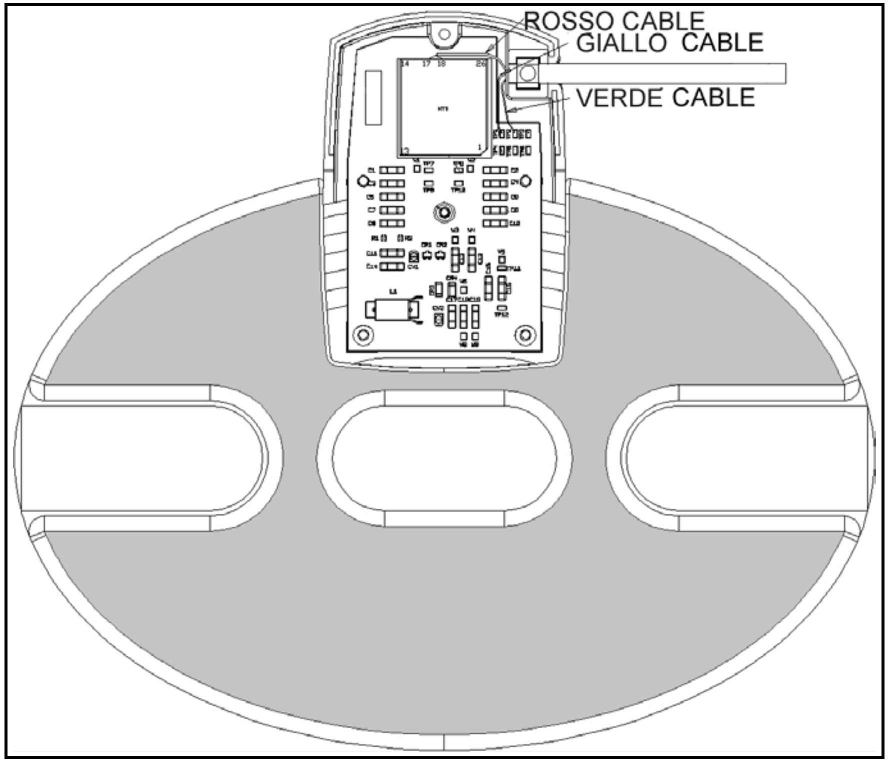
Fig. 111: Jumper positions on the Tuning circuit



Coil 6 Flex

- The Service Coil 6 is tuned at 7.65 MHz: if the Magnet frequency is between 7.6 and 7.7 MHz go directly to the next paragraph Coil Calibration; if the magnet frequency is over the range 7.6 ÷ 7.7 MHz go ahead the procedure
- Open the cover to gain access to the Tuning circuits

Fig. 112: Coil 6 Flex



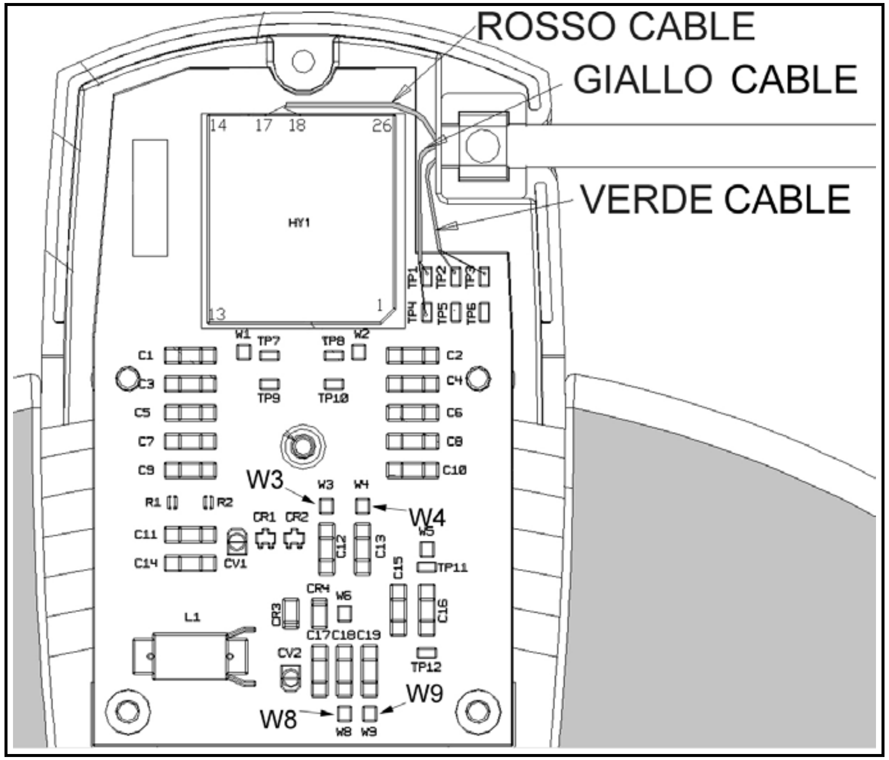
- Find the Magnet frequency in the following table, then identify the Jumpers on the Tuning circuit and set the Coil in according to the Magnet frequency and to the table

Tab. 27: Coil settings

Frequency of the magnet	**W3**	**W4**	**W8**	**W9**
7.5-7.6 MHz	Closed	Closed	Closed	Closed
7.6-7.6 MHz	*Closed*	*Open*	*Closed*	*Open*
7.7-7.8 MHz	Open	Open	Open	Open

Legend: Closed = leave or sold the SMD Jumper; Open = un-sold the SMD Jumper

Fig. 113: Coil 6 Flex circuit



Tab. 28: Test and adjustment

MODULE	TEST	ADJUSTMENT
RFM	Try to acquire one image	Calibrate the receiving channel offsets selecting, under ARAS, <**Test**> <**HW Automatic**> <**Channel Delay**>
ACM	Under ARAS, select <**Test**> <**Trouble Shoot.**> <**System Check**> and check if direct and reflect pulses are present then try to acquire some images	Calibrate the 180° Pulse of every coil selecting Under ARAS, select <**Test**> <**Automatic**> <**RF 180 Gain**>
SRFA	Under ARAS, select <**Test**> <**Trouble Shoot.**> <**System check**> and check if direct and reflect pulses are present.	Carry out automatically 180° pulse inside ARAS, select <**Test**> <**Automatic**> <> <**RF 180 Gain**> and calibrate the Transmission coil Under ARAS, select <**Test**> <**Trouble Shoot.**> <**TX coil**>
COIL	Try to acquire one image	Tune the Coil to Magnet frequency selecting, under ARAS, <**Test**> <**Automatic**> <**Coil Tuning**> and <**RF 180 Gain**> then save the values manually
GANTRY	Under ARAS, select <**Test**> <**Trouble Shoot.**> <**System check**> and check if direct and reflect pulses are present	Under ARAS, select <**Test**> <**Trouble Shoot.**> <**TX coil**> and set the gantry tuning and matching to the system frequency

Part 8 Patient Handling

Trouble shooting strategy

In this chapter you will find test strategies encompassing Patient Handling.

Refer to the Functional Description manual Patient Handling chapter for more information.

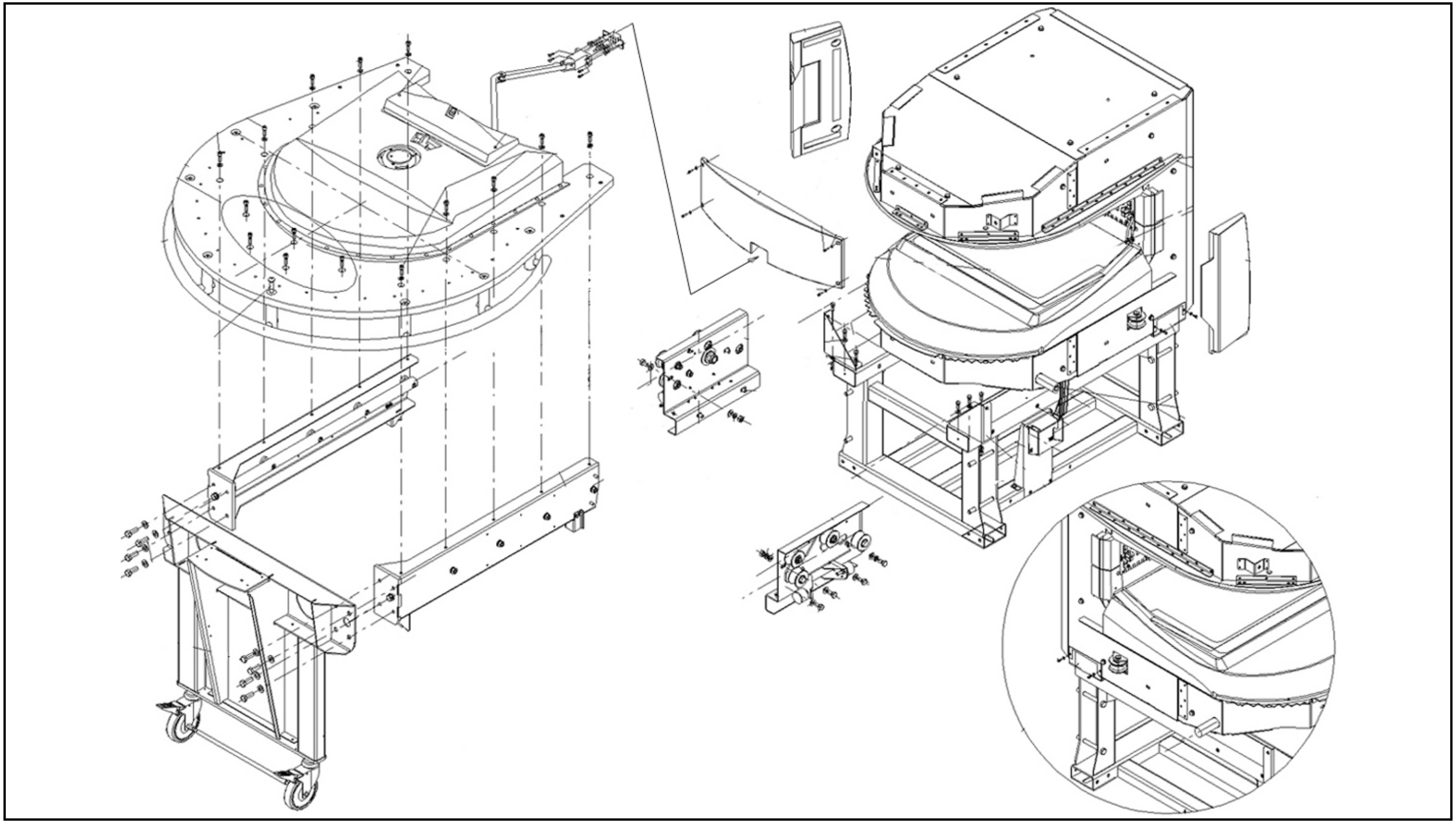
Procedure

- Check all the possible positions of the patient table
- Check the Patient Table handle and lock mechanism
- Check if the Patient Table can slide into and out of the magnet correctly
- Check the patient bed level and stability

If it is impossible to move the Patient Table or if it is not stable follow the Repair instructions to identify and fix the problem.

Repair

Fig. 114: Magnet Accessories Assembling

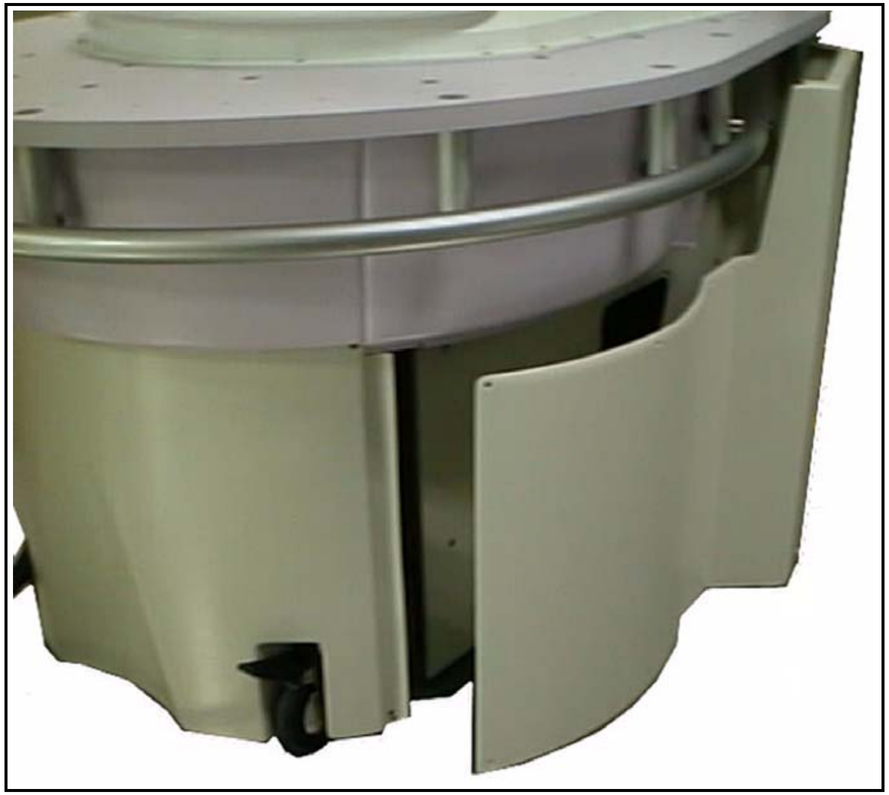


Magnet Brackets

The two magnet brackets, one each side, make it possible to move the patient bed.

- Remove the two lower lateral covers of the patient bed. Screws are fitted along the covers to fix them to the other covers and on the top to fix them to the round table on the patient bed

Fig. 115: Lower lateral cover



- Now remove the horizontal bar shown in the following figures. To remove it unscrew the bolts on each side used to fix the horizontal bar to the vertical bars

Fig. 116: Horizontal bar

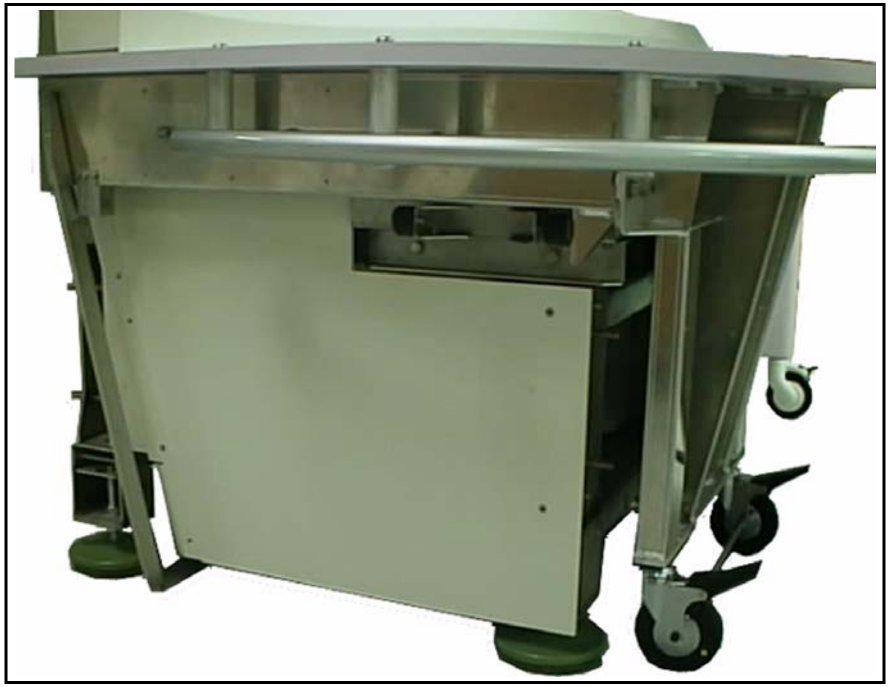
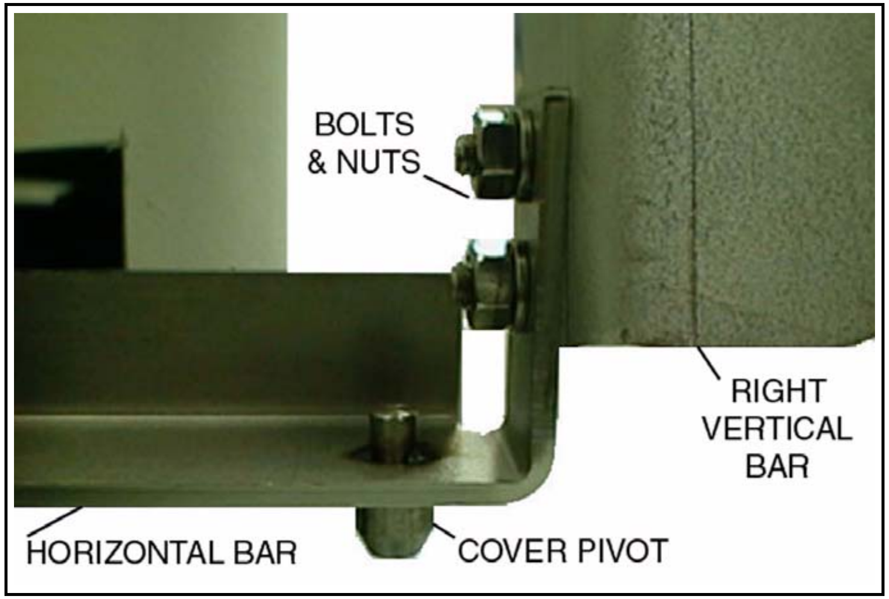
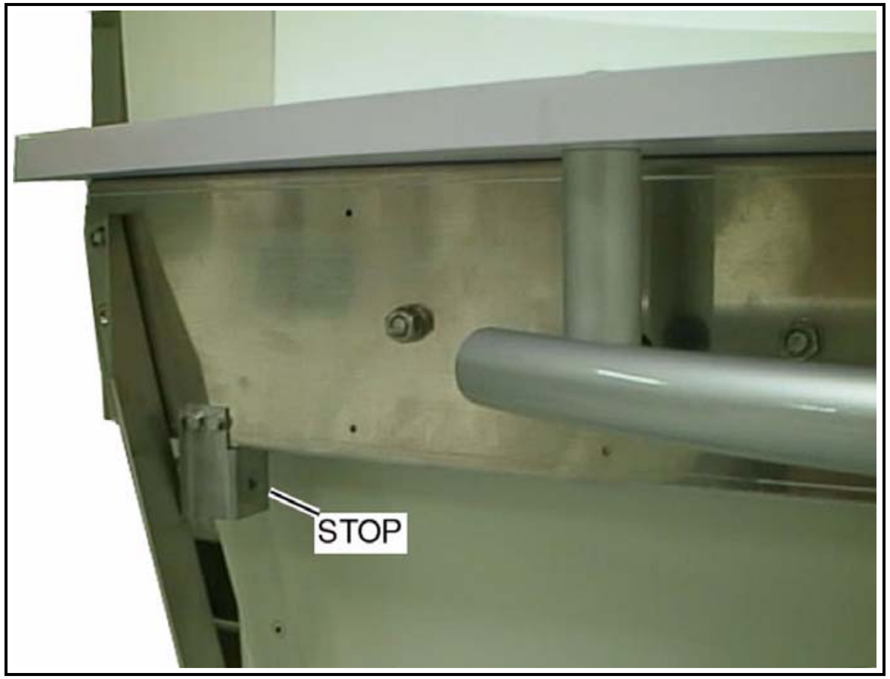


Fig. 117: Bolts fix the horizontal to the vertical bars



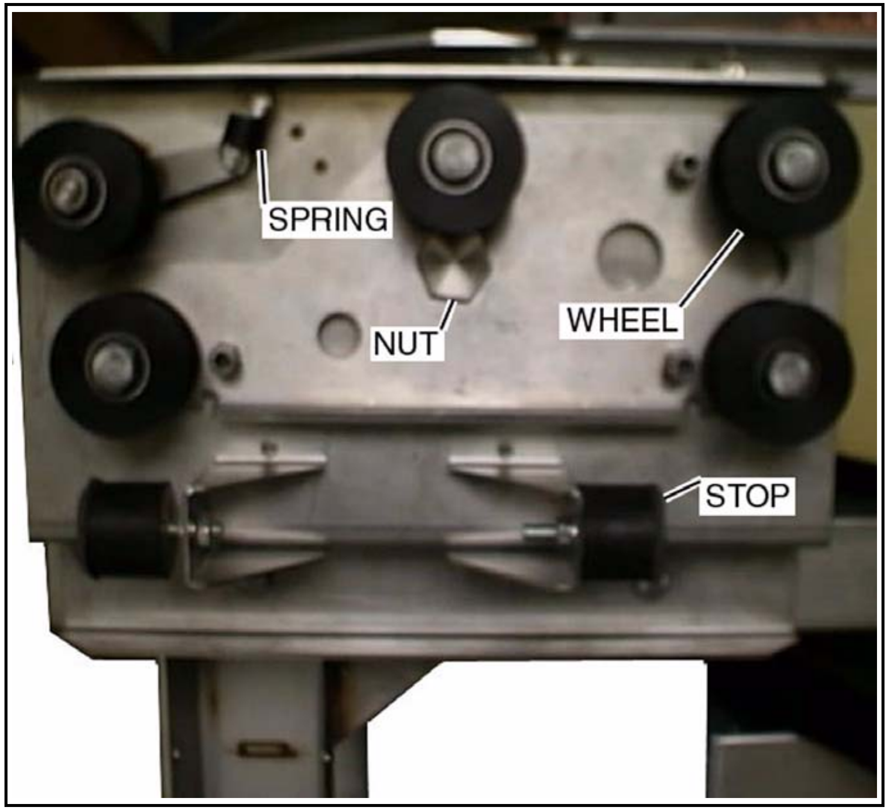
- To take the patient bed out completely you must first remove the two patient bed stops (one each s7ide) placed on the magnet brackets and fixed using two bolts, as shown in the following figure. In order to gain better access to them you can also remove the upper lateral covers

Fig. 118: Patient bed stop



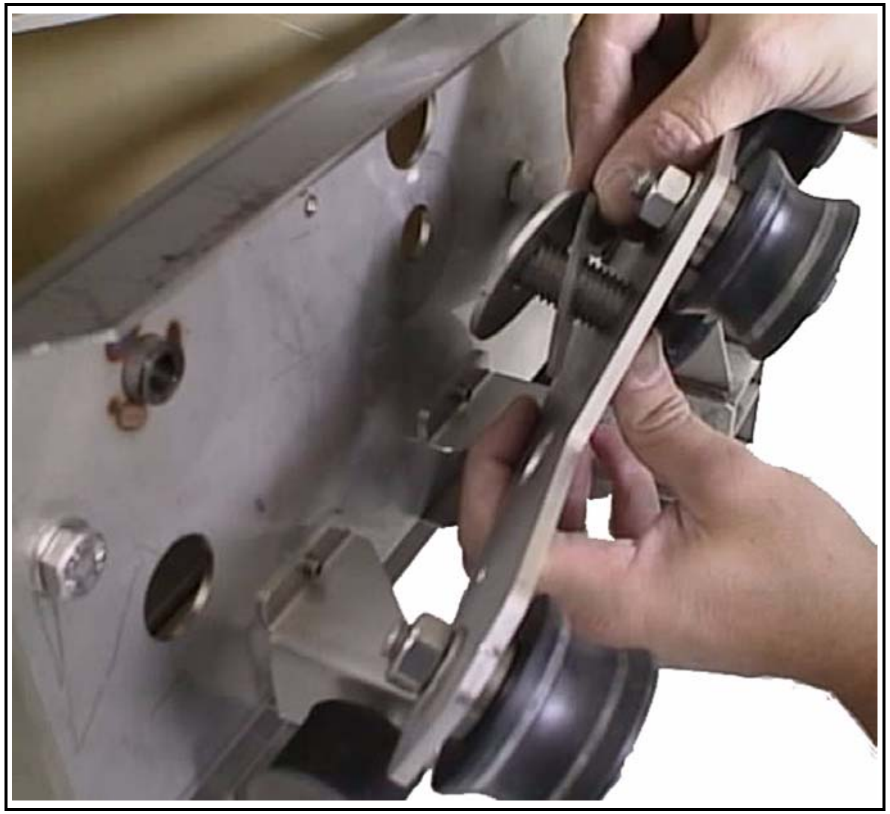
- Now take the patient bed out completely, to access the bracket mechanisms shown in the following figure

Fig. 119: Brackets mechanism (right side)



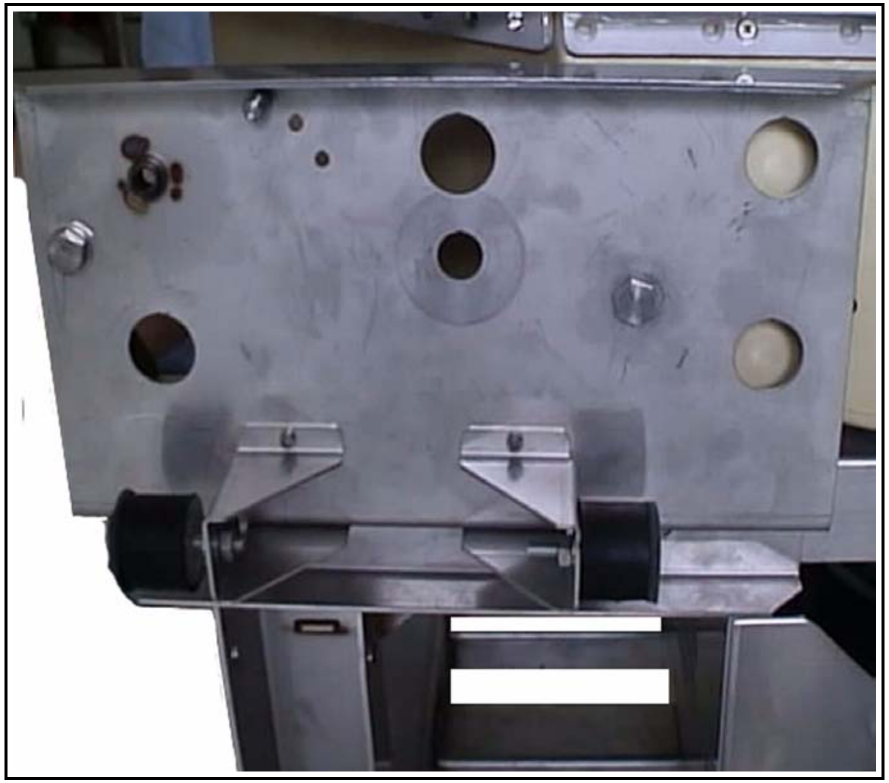
- To remove the mechanism, unscrew the NUT indicated in the previous figure. The removed mechanism is shown in the following figure

Fig. 120: Remove the mechanism



- The magnet brackets without mechanism are shown in the following figure

Fig. 121: Brackets mechanism removed



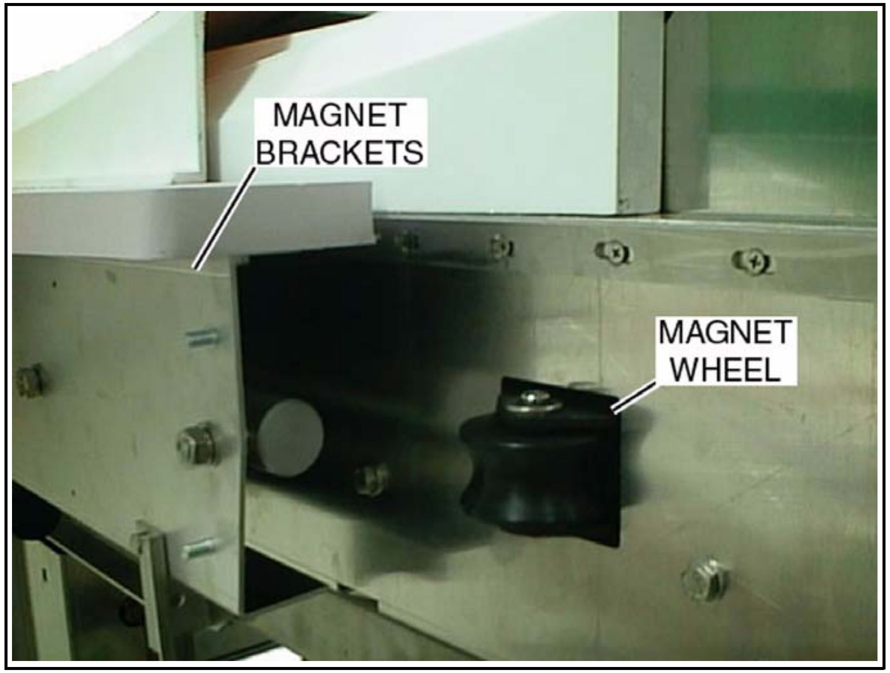
- Check the spring function and the bed stop position: loosen the nuts, move the stops (two front and two rear per side) and tighten the nuts again to fix it in the correct position

Brackets level

It is very important to check the movement of the magnet brackets: check if they slide on the magnet wheels in the correct way.

Remove the lateral Patient Table covers as explained before and check the correct bracket movement (as shown in the following two pictures)

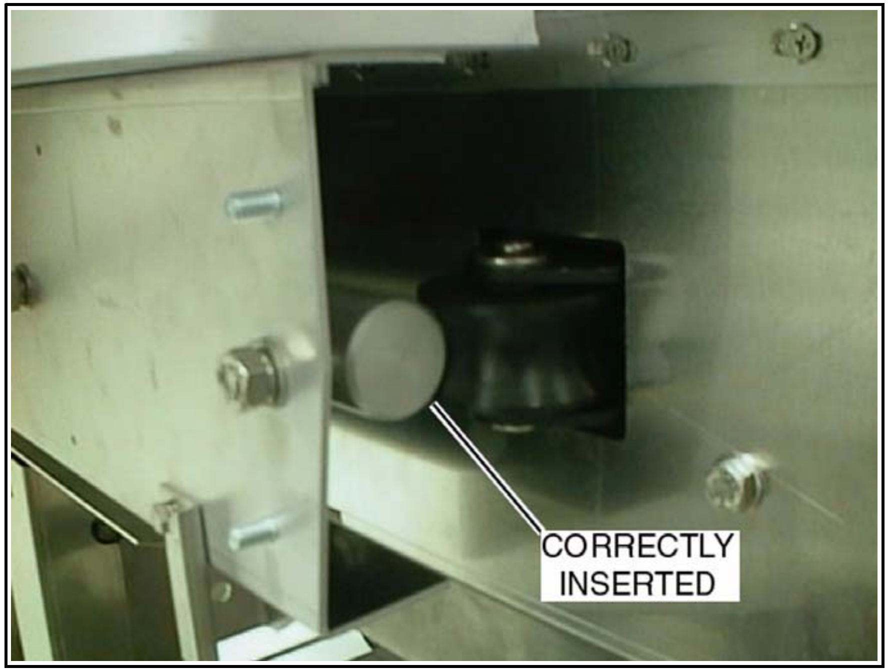
Fig. 122: Check the magnet brackets movement



If the patient bed or the magnet wheels are not at the correct height you can adjust it. See above how to adjust the patient bed height.

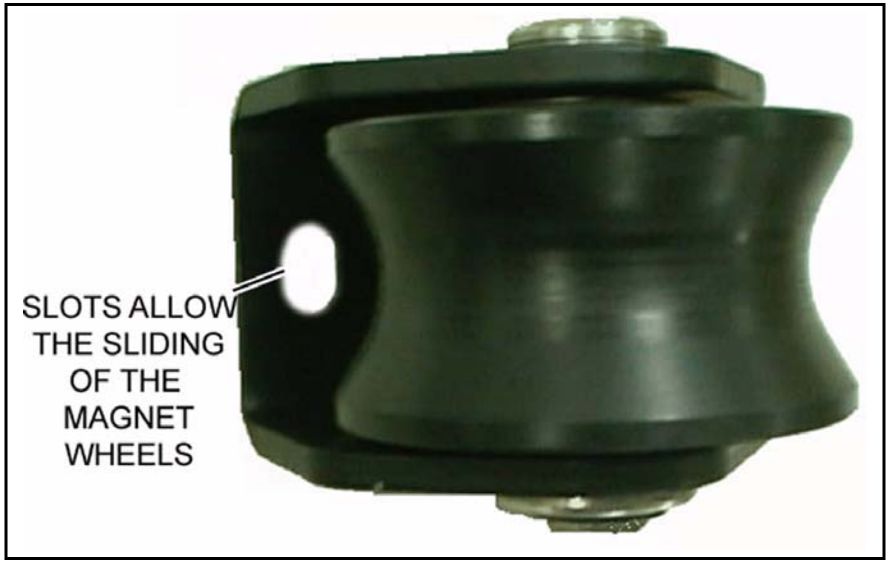
The magnet wheels can be removed: remove the two bolts per wheel and put on the rectangular piece if you must increase the distance between the wheel and the magnet, or move the wheel up or down, if you need to increase or decrease the wheel height.

Fig. 123: The patient bed is adjusted properly



The two wheel bolts are inserted in long slots and not in circular holes (shown in the next figure).

Fig. 124: Magnet wheels structure



Round Part of the Patient Table Level

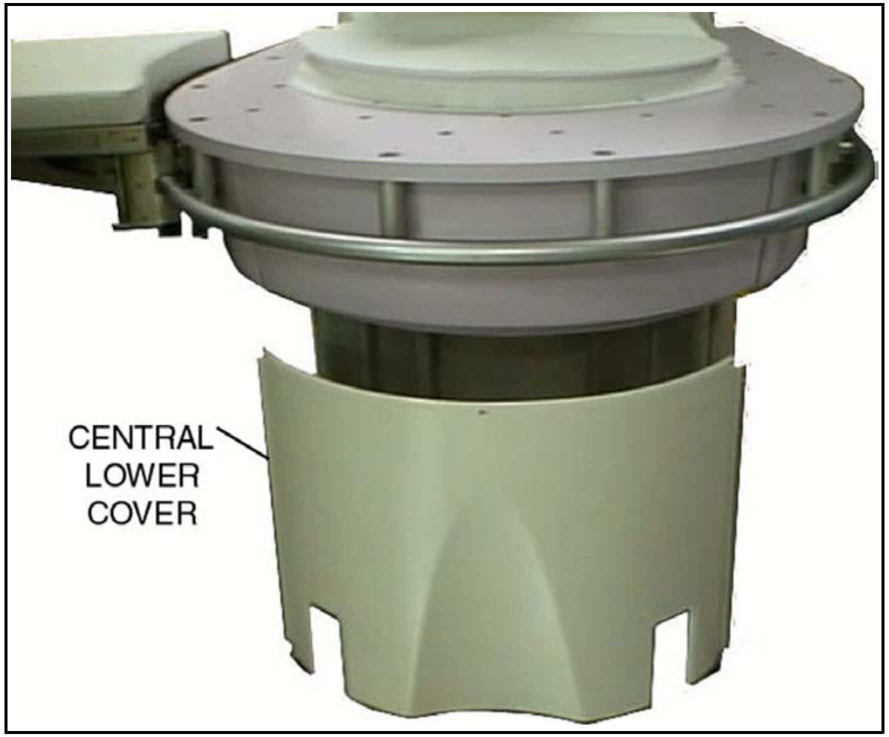
Test if you can complete the bed extension and if the wheels touch the floor during the movement.

Otherwise you can adjust the wheeled structure height turning the nuts already mounted on the wheel pivots.

To access the nuts, follow this procedure:

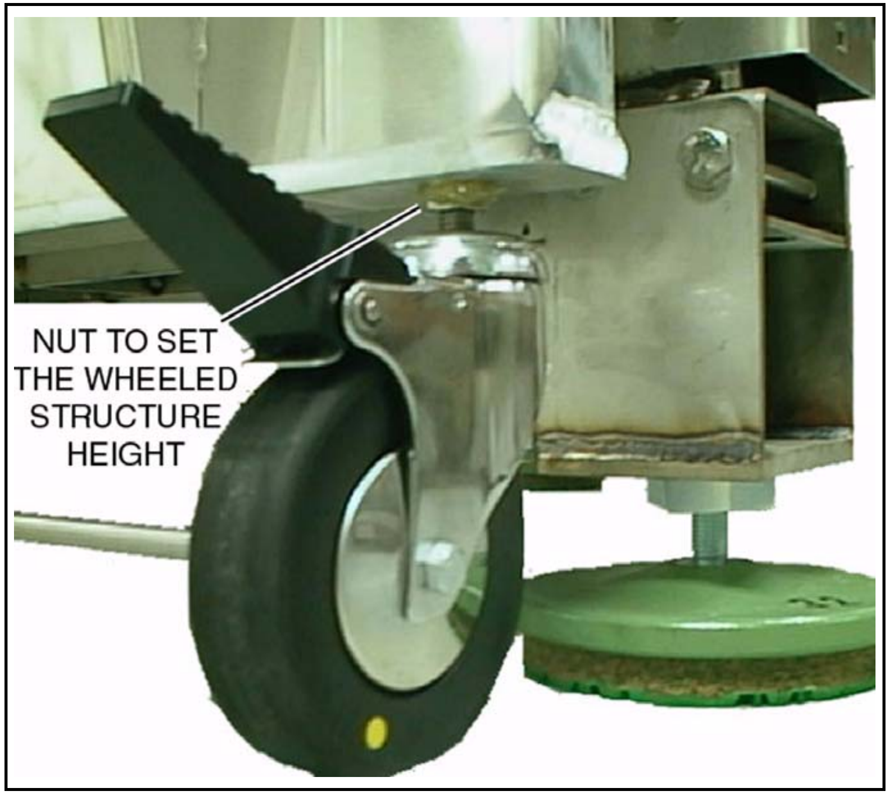
- Remove the central lower cover

Fig. 125: Central lower cover



- Now you can adjust the wheeled structure height

Fig. 126: Wheels pivot nut position



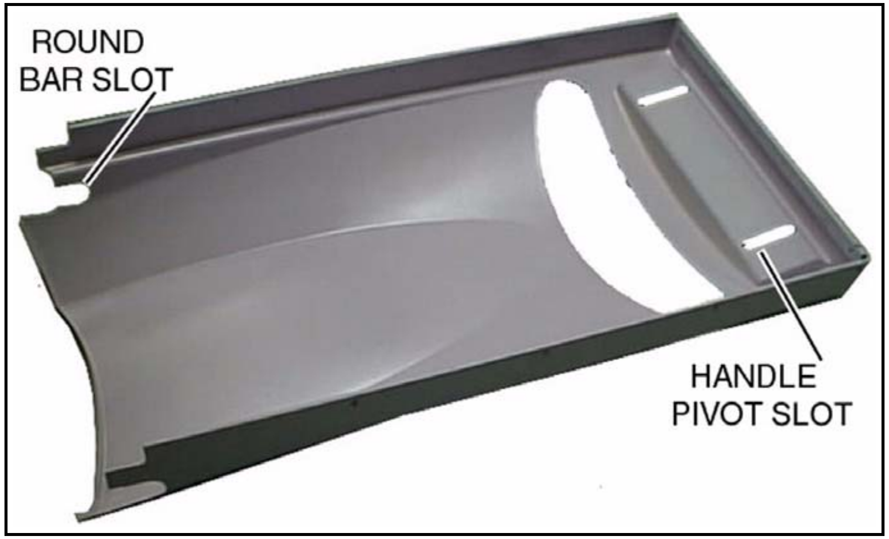
- At the end of the procedure, re-install the covers

Patient Table Mechanism

This mechanism makes it possible to lock the patient table in different positions along the round bar. To use it you must pull up the patient table handle on the front of the patient table as shown in the following figure.

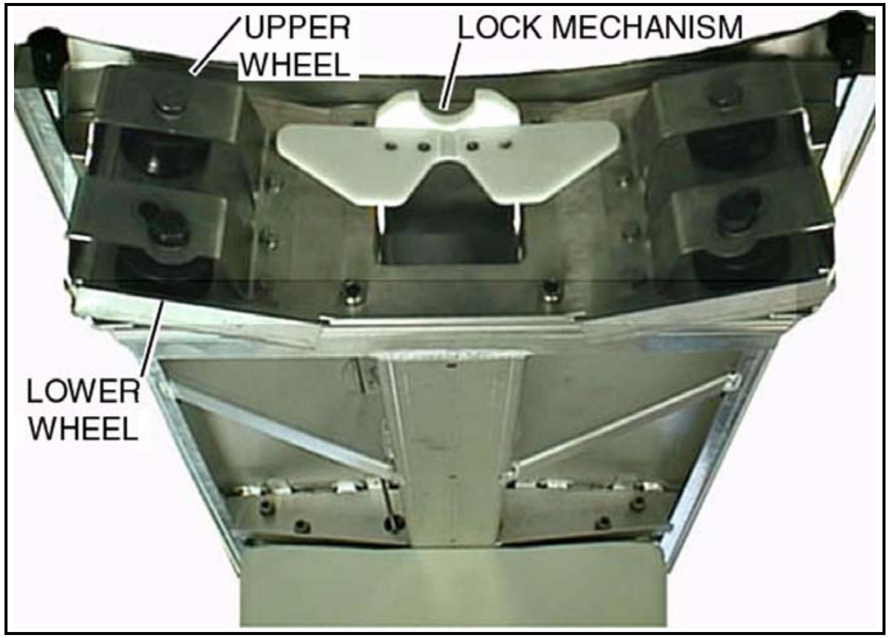
- Remove the patient table handle, unscrewing the two screws that fix it to the handle pivots
- Remove the patient table cover, unscrewing the screws along the cover edge

Fig. 127: Patient bed cover



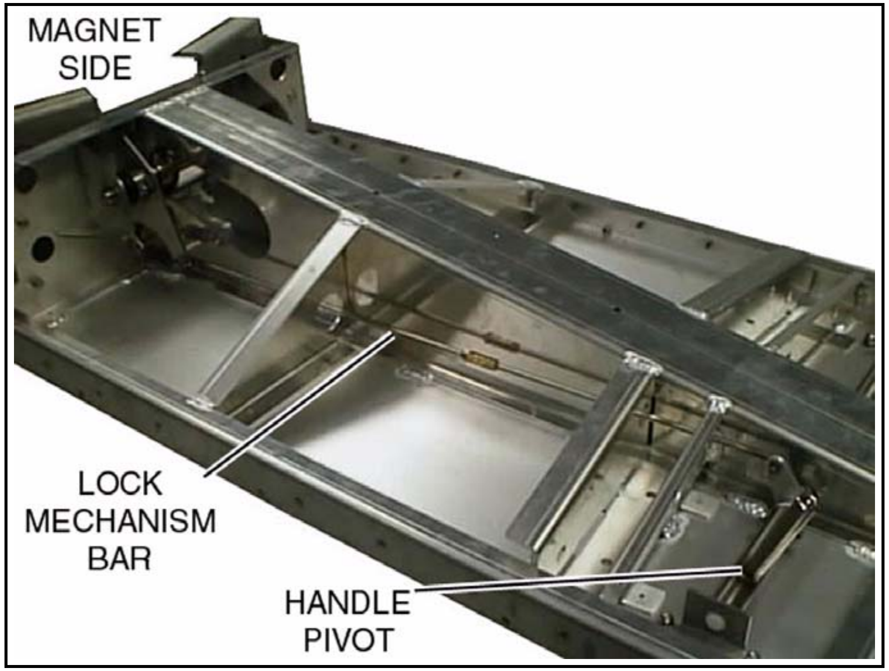
- At the back of the patient bed, screw the two nuts (one per bolt) and put the wheels in the lowest position, as shown in the following figure

Fig. 128: Rear side of the patient bed



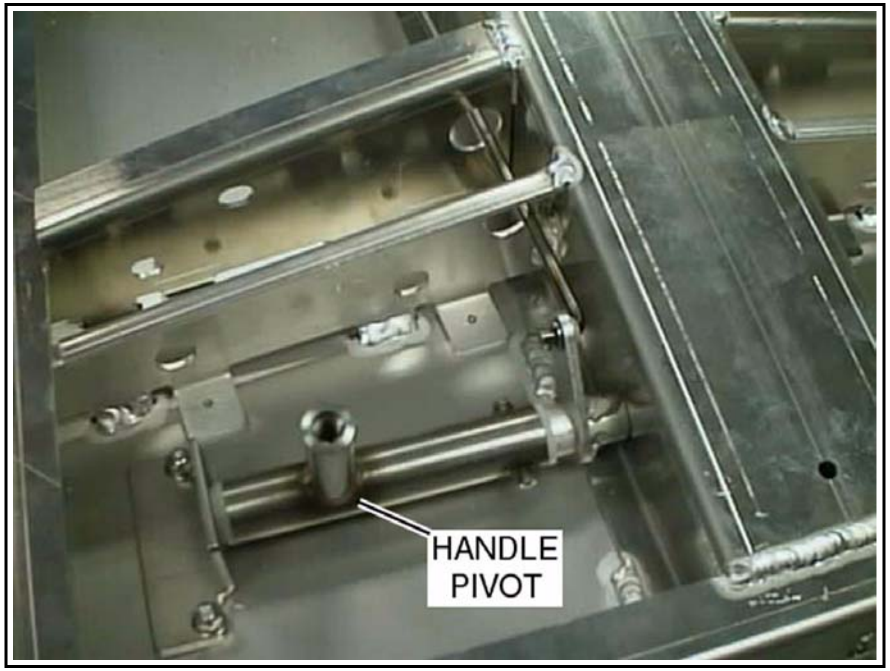
- The round bar slides between the highest and lowest wheel
  - Put the patient bed lock in the upper position, using the handle pivots, and take out the patient bed from the round bar
  - Now the mechanism is accessible, rotating the patient bed upside down, as shown in the following figure

Fig. 129: Patient bed lock mechanism



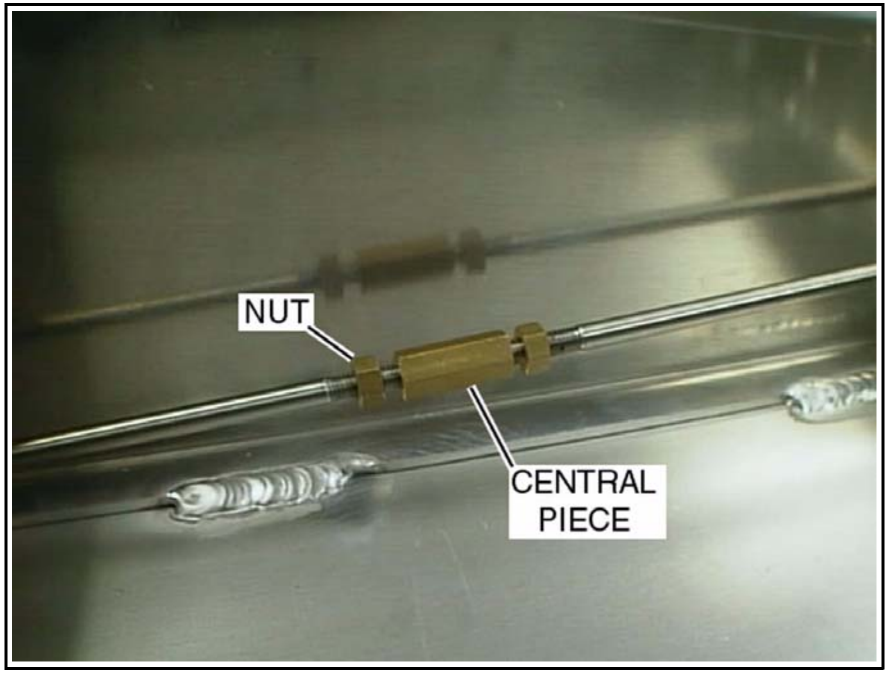
The next figure shows the handle pivot and how it is connected to the locking mechanism bar.

Fig. 130: Handle pivot and lock mechanism bar



You can adjust the length of the locking mechanism bar at the middle.

Fig. 131: Bed lock mechanism bar



Screw cuttings are present on the lock mechanism bar: unscrew the nuts to adjust it, rotating the central piece and then screw them again for normal use.

The last part of the mechanism is placed at the back of the patient bed. In the following two figures you can see it and the position of the spring used to lock the patient bed automatically by moving it along the round bar.

Fig. 132: Spring position

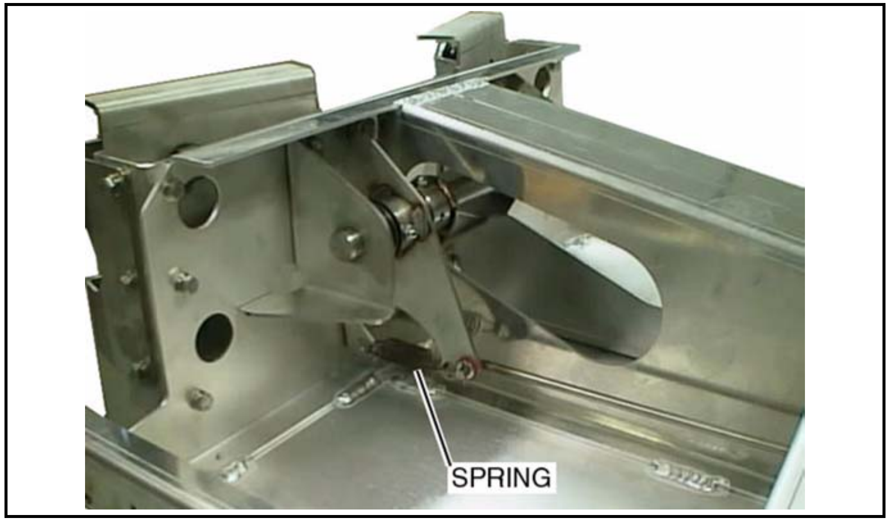
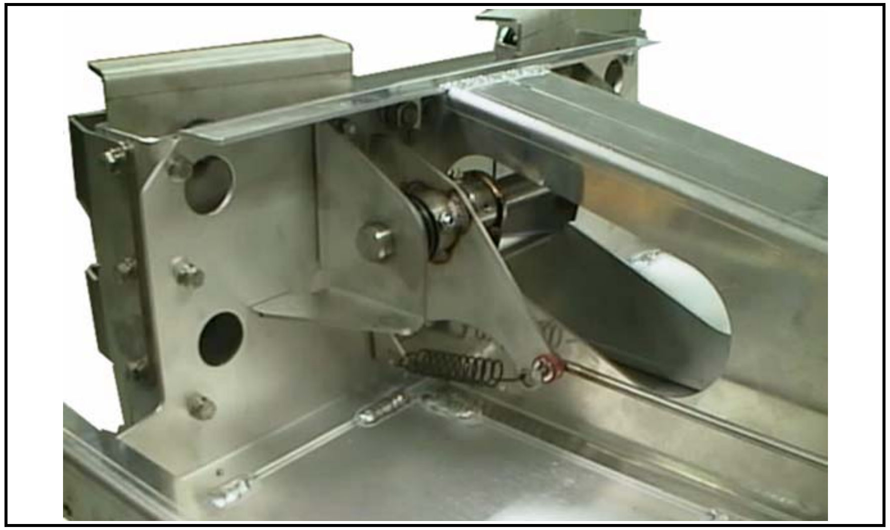
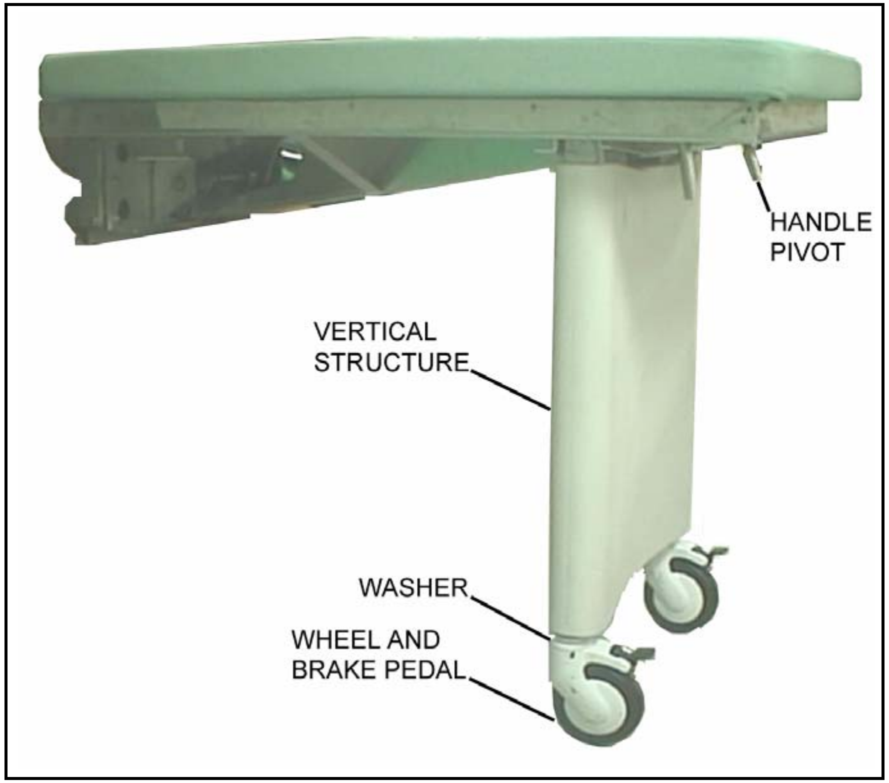


Fig. 133: Lift up the handle to release the patient bed



Patient Table Level

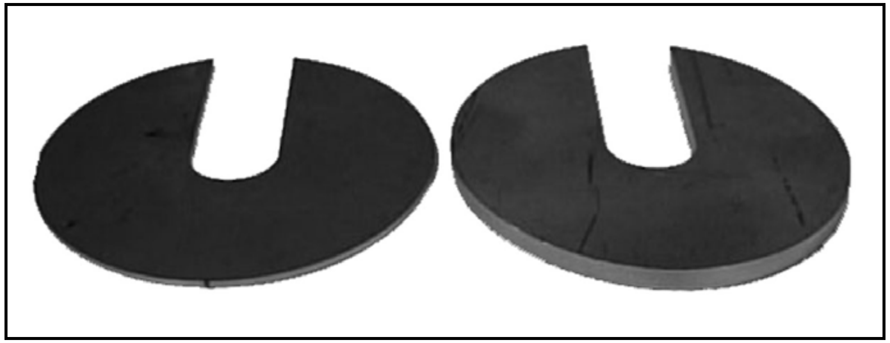
Fig. 134: Patient bed



You can adjust the patient table height and level putting special washers, of different thickness, on the wheel pivots between the wheels and the vertical structure of the patient bed.

The special washers are shown in the following figure.

Fig. 135: Patient bed washers with different thickness



Now check if you can move the patient bed in all its possible positions and if the wheels touch the floor during the whole movement.

Part 9 Gradient

Trouble shooting strategy

In this section you will find test strategies, procedures and repair instructions encompassing the complete gradient system.

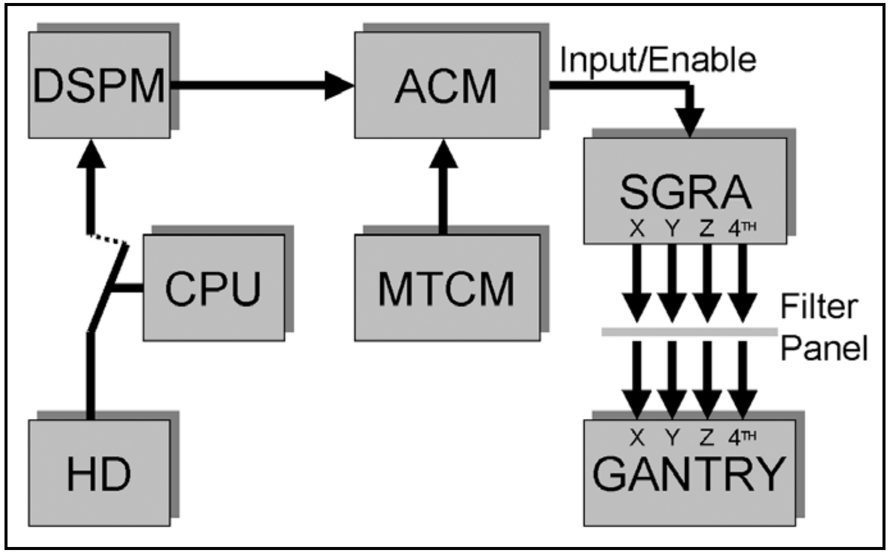
For more information refer to the Functional Description manual Gradient chapter.

Procedure

Gradient driving Chain

A description of the process and which modules are responsible for the transmission process is shown in the following figure.

Fig. 136: Gradient Driving Chain



Use of the system Check

Select the test and wait for the diascope, then click on the **<Channel>** button and move the arrows to change the logical channel. When you select channel 0, the first line at the top right corner of the monitor shows the label “**X Grad”**; channels 1 represents the “**Y GRAD”**, channel 2 the “**Z GRAD”** and channel 3 the “**4th GRAD”**.

The blue trace (real component) is the driving voltage of the gradient amplifier's X channel (SGRA module), measured at the output of the ACM module, located in the Signal Box. The red trace (imaginary component) is the output current of the SGRA X channel, measured by shunting a part of it from the corresponding final stage.

If the coil relative to the Y gradient is driven correctly, the monitor will display this waveform (use the **<Res. Div.>** and **<Dec Div>** commands to display the optimal dimensions) for both channels.

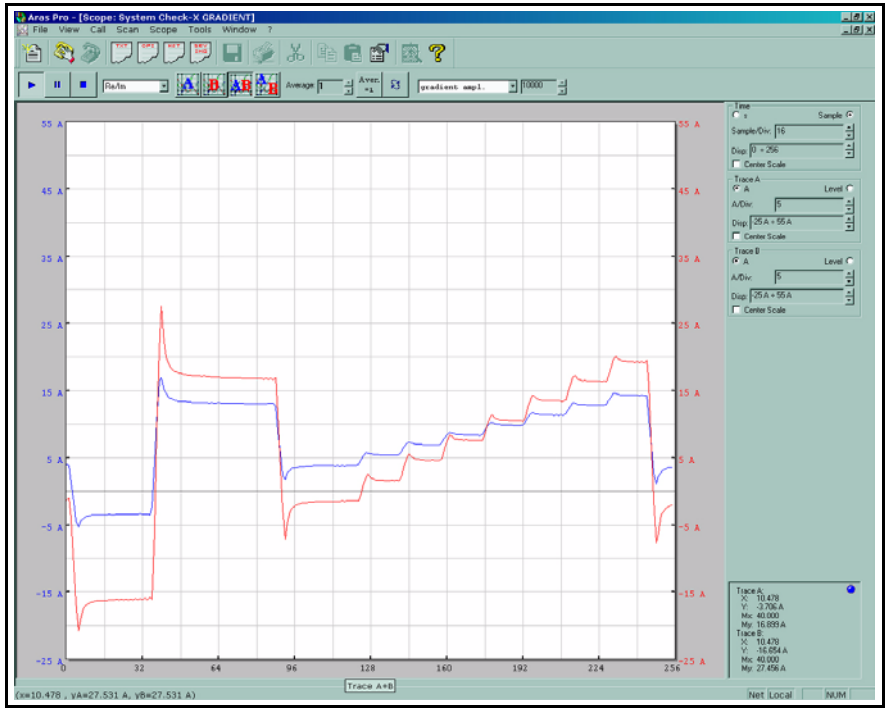
Please note that the SGRA drive voltage (blue trace) must have a rather square shape since it is driven directly by the D/A (except for gains and offset). Whilst the output current (red trace), besides the different gain value, shows overshoots and undershoots generated by the eddy current compensation circuit located at SGRA input.

Obviously, using the apparatus as an oscilloscope assumes that the acquisition subsystem (consisting of the DSPM and ACM modules) is operating correctly. Any problems with this subsystem must be identified if, for instance, the oscilloscope behaves incorrectly regardless of the selected channel.

If the blue trace (GRA input from ACM) is correct, but the gray (GRA output) is not, there is probably a problem with the gradient amplifier.

If the blue trace is not correct as well, probably the problem is with the ACM module (or DSPM which programs the ACM).

Fig. 137: Gradient waveforms



Time
○ s Sample ●
Sample/Div: 16
Disp: 0 ÷ 256
☐ Center Scale

Trace A
● A Level ○
A/Div: 5
Disp: -25 A ÷ 55 A
☐ Center Scale

Trace B
● A Level ○
A/Div: 5
Disp: -25 A ÷ 55 A
☐ Center Scale

Trace A:
X: 10.478
Y: -3.706 A
Mx: 40.000
My: 16.899 A
Trace B:
X: 10.478
Y: -16.654 A
Mx: 40.000
My: 27.456 A

(x=10.478 , yA=27.531 A, yB=27.531 A)

- Disconnect the SGRA gradient cables
- Using the Voltmeter measure the voltage values between **PLUS** and **MINUS** connectors of every gradient:
  – X, Y and Z must be more or less 75 V
  – IV must be more or less 35 V
- Using an ohmmeter measure the resistance value of every gradient coil between the **PLUS** and **MINUS** connectors of every gradient cable:

X, Y, Z and IV Ch must be more or less 0.2 ohm

SGRA led status check

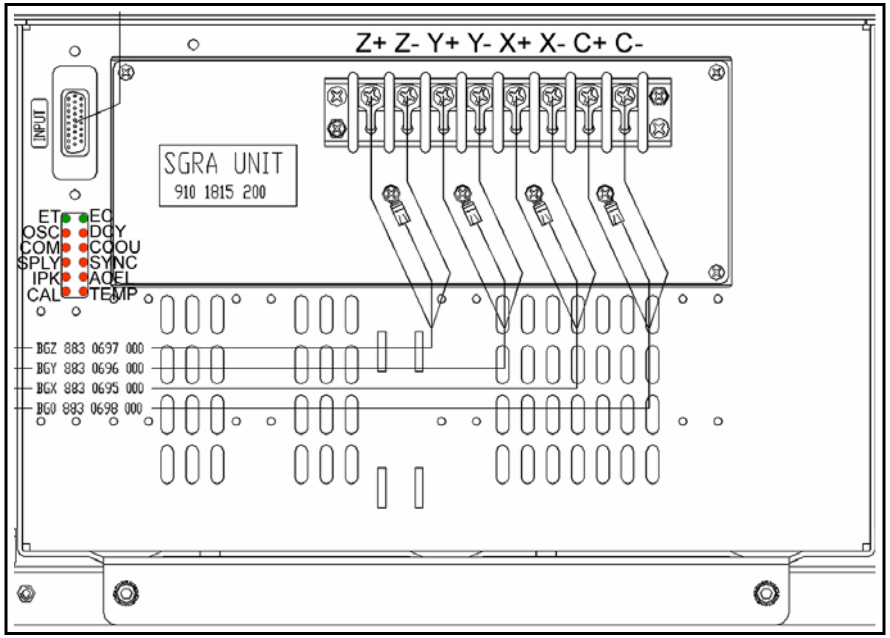
Open the Electronic Unit and check the SGRA led status meaning:

Tab. 29: SGRA led status meaning

Led	Normal	Error	Error Meaning
ET	On	Off	Missing enable from MTCM
EC	On	Off	Missing enable from ACM
OSC	Off	On	Input regulator error
DCY	Off	On	SGRA disabled by duty-cycle problem
COM	Off	On	Communication problem or digital trimmer not loaded
CCOU	Off	On	Output in short circuit
SPLY	Off	On	Missing or bad power supply
SYNC	Off	On	Missing or bad synchronism
IPK	Off	On	Overshoot current over thresholds
ACFL	Off	On	Trimmer not programmed
CAL	Off	On	SGRA waiting for command
TEMP	Off	On	SGRA in over temperature

NOTICE When the System is switched on the led COM and CAL are on waiting for commands!!!

Fig. 138: SGRA Module (inside Electronic Unit) (image rotated 90° CCW)



Repair

Necessary tools

- Allen key 4 mm
- Flat screwdriver
- Small Spherical Phantom and its support
- Geometrical phantom and its support

SGRA2 replacement

The SGRA module (gradient amplifier) is placed into the system console. Follow this procedure to replace it.

- Open the front and rear console covers
- Disconnect the SGRA power plug (rear side)
- Disconnect all the cables (front side) as shown in the next figure
- Take out the broken module and insert the new one replacing all the cables

Gradients Orientation Check

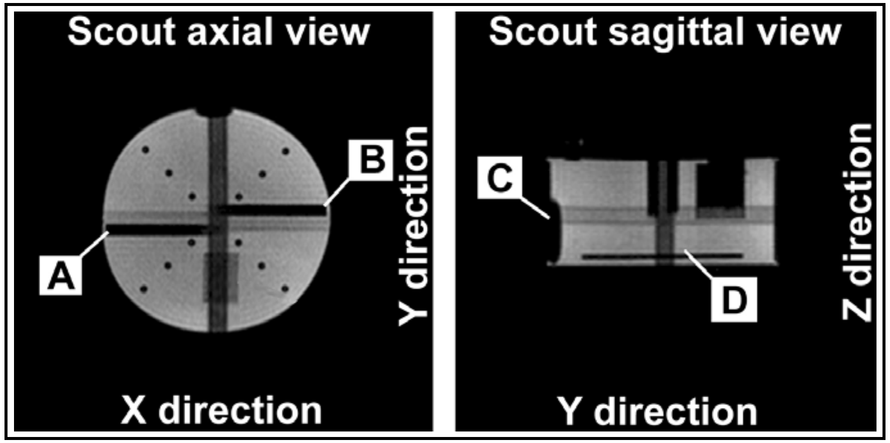
Introduction

Perform this check to identify gradient inversions.

Sequence operation

- Place the geometrical phantom into the Knee coil 2 taking care to place it with the plastic screw to the right side of the magnet (patient bed A position), then insert the Knee coil into the magnet
- Perform a scout selecting the district **<Other>** and **<A>** position on the patient bed
- Compare the first two scout images (axial and sagittal) to the images shown: they must be equal. If they have a different orientation check the gradient cables looking for inversions then repeat this test until the correct scout images are obtained

Fig. 139: Scout images



4th Channel Polarity Check

- Under ARAS select **<Test> <Troubleshoot.> <4 Ch. Polarity> <Exec>** and the system will perform automatically the polarity check of the 4th Channel looking for cable inversion
- The system will ask to insert the Knee Coil 2 and the small spherical phantom

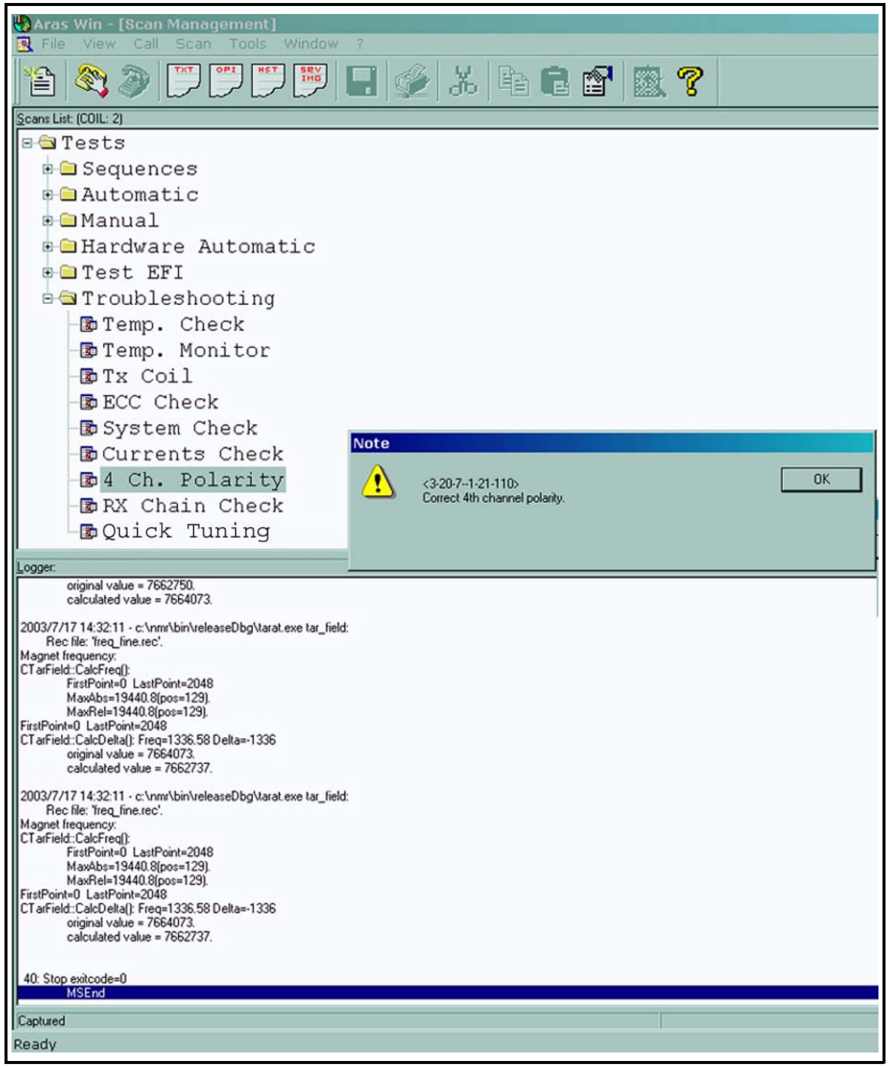
NOTICE	The system will show the Phase stability window message only in case of incorrect value, if the value is correct the procedure will continue automatically. In case of Phase Stability problem perform the magnetic compensation procedure then calibrate the System

- If any inversion is present the system will show you a correct polarity message. In case of inversion the system will show you a message with the opposite meaning: check the 4th channel cables connected to the SGRA and to the filter panel (internal and external side) looking for any inversion, then repeat the test

⚠**WARNING**	**In case of inversion, the Magnetic Compensation Procedure must be repeated because the 4th Ch Coil is used to perform the Magnetic Compensation**

- When the correct message is displayed, fill in the **Installation Quality Form**

Fig. 140: Test correct result



```
<3-20-7--1-21-110>
Correct 4th channel polarity.
```

```
          original value = 7662750.
          calculated value = 7664073.

2003/7/17 14:32:11 - c:\nmr\bin\releaseDbg\tarat.exe tar_field:
     Rec file: 'freq_fine.rec'.
Magnet frequency:
CTarField::CalcFreq():
          FirstPoint=0  LastPoint=2048
          MaxAbs=19440.8(pos=129).
          MaxRel=19440.8(pos=129).
FirstPoint=0  LastPoint=2048
CTarField::CalcDelta(): Freq=1336.58 Delta=-1336
          original value = 7664073.
          calculated value = 7662737.

2003/7/17 14:32:11 - c:\nmr\bin\releaseDbg\tarat.exe tar_field:
     Rec file: 'freq_fine.rec'.
Magnet frequency:
CTarField::CalcFreq():
          FirstPoint=0  LastPoint=2048
          MaxAbs=19440.8(pos=129).
          MaxRel=19440.8(pos=129).
FirstPoint=0  LastPoint=2048
CTarField::CalcDelta(): Freq=1336.58 Delta=-1336
          original value = 7664073.
          calculated value = 7662737.


 40: Stop exitcode=0
          MSEnd
```

ECC Tune

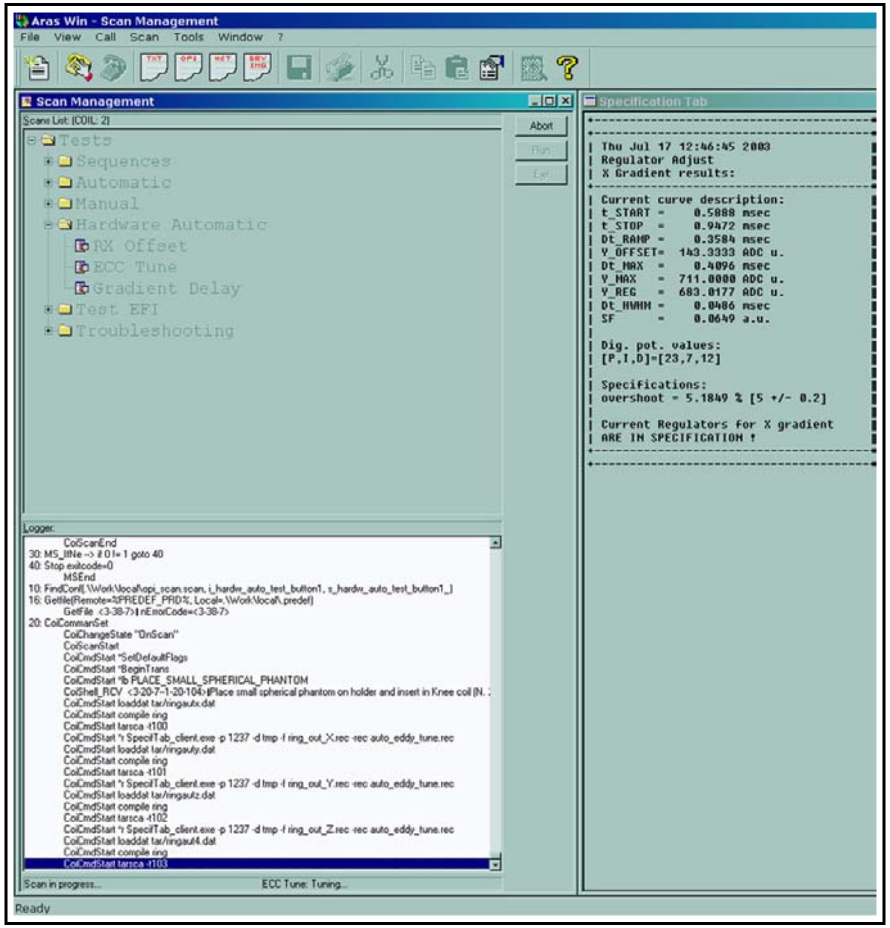
- Insert the Knee Coil 2 with the Small Spherical phantom in it
- Perform one scout selecting the district <Other> and <A> bed patient
- Under ARAS select **<Test> <HW Automatic> <ECC Tune> <Exec>** then follow the software instructions and the system will automatically calibrate the SGRA module. The automatic procedure comprehends: the Regulator calibrations (X, Y, Z and 4th channel), the Phase Stability check, the phantom position check (axial, sagittal and coronal images) and the ECC (acronym for eddy current compensation) tune

NOTICE	The system will show the Phase stability window message only in case of incorrect value, if the value is correct the procedure will continue automatically. In case of Phase Stability problem perform the magnetic compensation procedure and repeat the ECC Tune

NOTICE	If the procedure is aborted the values are not saved and the system restores the original values

- The system will ask you to insert the small spherical phantom into the Knee coil 2
- The first automatically step is the Regulator calibration: the system will show the regulator value after every channel calibration like shown in the following figures

Fig. 141: X channel regulator calibration message window



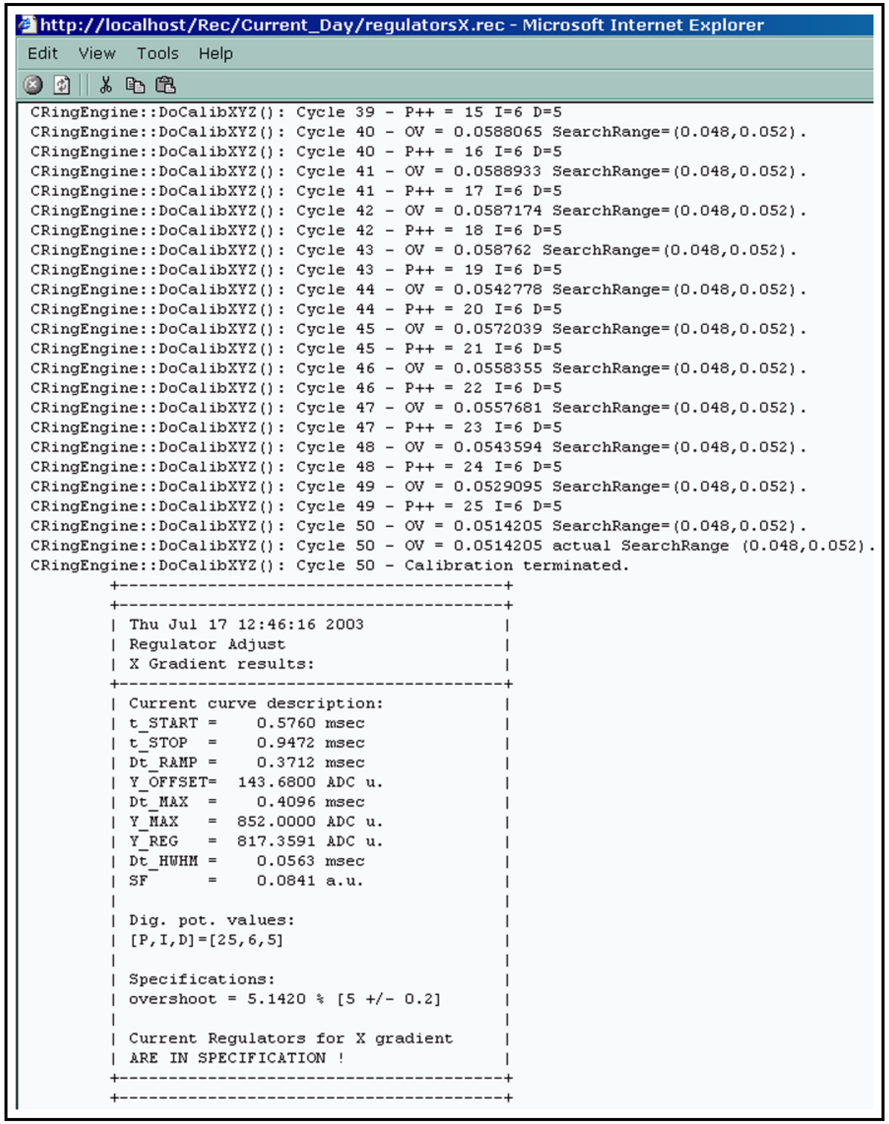
```
+------------------------------------------------+
+------------------------------------------------+
| Thu Jul 17 12:46:45 2003
| Regulator Adjust
| X Gradient results:
+------------------------------------------------+
| Current curve description:
| t_START =     0.5888 msec
| t_STOP  =     0.9472 msec
| Dt_RAMP =     0.3584 msec
| V_OFFSET=   143.3333 ADC u.
| Dt_MAX  =     0.4096 msec
| V_MAX   =   711.0000 ADC u.
| V_REG   =   683.0177 ADC u.
| Dt_HWHM =     0.0486 msec
| SF      =     0.0649 a.u.
|
| Dig. pot. values:
| [P,I,D]=[23,7,12]
|
| Specifications:
| overshoot = 5.1849 % [5 +/- 0.2]
|
| Current Regulators for X gradient
| ARE IN SPECIFICATION !
+------------------------------------------------+
+------------------------------------------------+
```

```
        CoiScanEnd
30: MS_IfNe --> if 0 != 1 goto 40
40: Stop exitcode=0
        MSEnd
10: FindConf(.\Work\local\opi_scan.scan, i_hardw_auto_test_button1, s_hardw_auto_test_button1_)
16: Getfile(Remote=%PREDEF_PRD%, Local=.\Work\local\.predef)
        GetFile  <3-38-7>|nErrorCode=<3-38-7>
20: CoiCommanSet
        CoiChangeState "OnScan"
        CoiScanStart
        CoiCmdStart "SetDefaultFlags
        CoiCmdStart "BeginTrans
        CoiCmdStart "lb PLACE_SMALL_SPHERICAL_PHANTOM
        CoiShell_RCV  <3-20-7--1-20-104>|Place small spherical phantom on holder and insert in Knee coil (N. 
        CoiCmdStart loaddat tar/ringautx.dat
        CoiCmdStart compile ring
        CoiCmdStart tarsca -t100
        CoiCmdStart "r SpecifTab_client.exe -p 1237 -d tmp -f ring_out_X.rec -rec auto_eddy_tune.rec
        CoiCmdStart loaddat tar/ringauty.dat
        CoiCmdStart compile ring
        CoiCmdStart tarsca -t101
        CoiCmdStart "r SpecifTab_client.exe -p 1237 -d tmp -f ring_out_Y.rec -rec auto_eddy_tune.rec
        CoiCmdStart loaddat tar/ringautz.dat
        CoiCmdStart compile ring
        CoiCmdStart tarsca -t102
        CoiCmdStart "r SpecifTab_client.exe -p 1237 -d tmp -f ring_out_Z.rec -rec auto_eddy_tune.rec
        CoiCmdStart loaddat tar/ringaut4.dat
        CoiCmdStart compile ring
        CoiCmdStart tarsca -t103
```

```
Scan in progress...          ECC Tune: Tuning...
Ready
```

- After the complete calibration it's possible to check the Regulator obtained values reading the **regulatorsX.rec** (and Y, Z and IV CH of course) file and scrolling it to read the Channel values. If this file is opened during the calibration the system will not refresh it: quit and re-open the file to refresh it

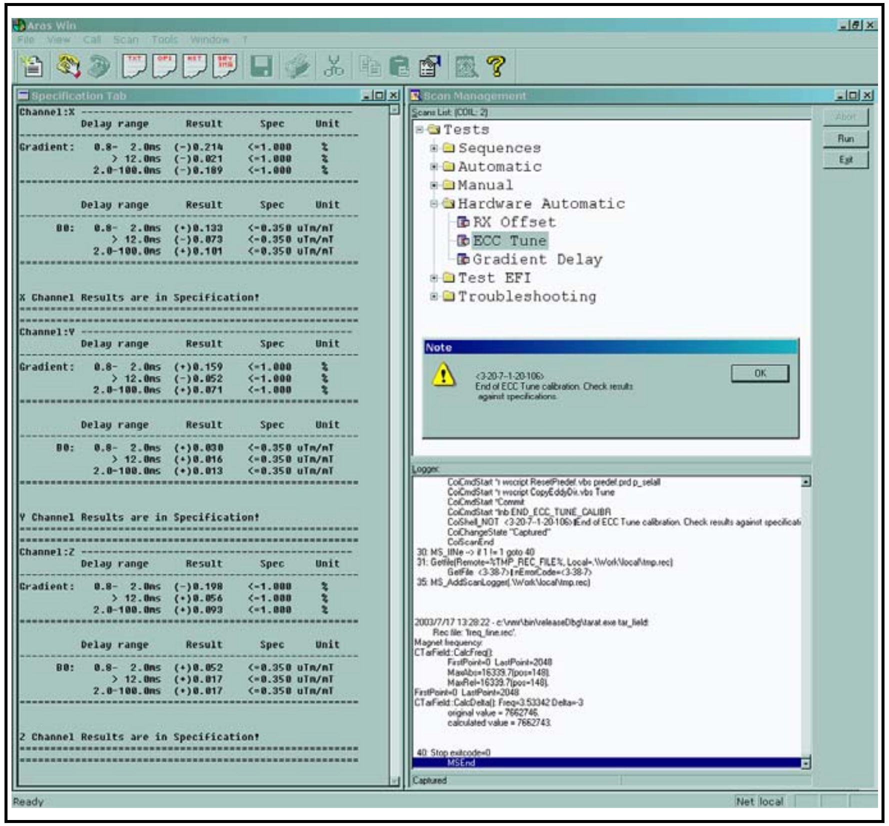
Fig. 142: Regulators4.rec


http://localhost/Rec/Current_Day/regulatorsX.rec - Microsoft Internet Explorer
Edit
View
Tools
Help

```
CRingEngine::DoCalibXYZ(): Cycle 39 - P++ = 15 I=6 D=5
CRingEngine::DoCalibXYZ(): Cycle 40 - OV = 0.0588065 SearchRange=(0.048,0.052).
CRingEngine::DoCalibXYZ(): Cycle 40 - P++ = 16 I=6 D=5
CRingEngine::DoCalibXYZ(): Cycle 41 - OV = 0.0588933 SearchRange=(0.048,0.052).
CRingEngine::DoCalibXYZ(): Cycle 41 - P++ = 17 I=6 D=5
CRingEngine::DoCalibXYZ(): Cycle 42 - OV = 0.0587174 SearchRange=(0.048,0.052).
CRingEngine::DoCalibXYZ(): Cycle 42 - P++ = 18 I=6 D=5
CRingEngine::DoCalibXYZ(): Cycle 43 - OV = 0.058762 SearchRange=(0.048,0.052).
CRingEngine::DoCalibXYZ(): Cycle 43 - P++ = 19 I=6 D=5
CRingEngine::DoCalibXYZ(): Cycle 44 - OV = 0.0542778 SearchRange=(0.048,0.052).
CRingEngine::DoCalibXYZ(): Cycle 44 - P++ = 20 I=6 D=5
CRingEngine::DoCalibXYZ(): Cycle 45 - OV = 0.0572039 SearchRange=(0.048,0.052).
CRingEngine::DoCalibXYZ(): Cycle 45 - P++ = 21 I=6 D=5
CRingEngine::DoCalibXYZ(): Cycle 46 - OV = 0.0558355 SearchRange=(0.048,0.052).
CRingEngine::DoCalibXYZ(): Cycle 46 - P++ = 22 I=6 D=5
CRingEngine::DoCalibXYZ(): Cycle 47 - OV = 0.0557681 SearchRange=(0.048,0.052).
CRingEngine::DoCalibXYZ(): Cycle 47 - P++ = 23 I=6 D=5
CRingEngine::DoCalibXYZ(): Cycle 48 - OV = 0.0543594 SearchRange=(0.048,0.052).
CRingEngine::DoCalibXYZ(): Cycle 48 - P++ = 24 I=6 D=5
CRingEngine::DoCalibXYZ(): Cycle 49 - OV = 0.0529095 SearchRange=(0.048,0.052).
CRingEngine::DoCalibXYZ(): Cycle 49 - P++ = 25 I=6 D=5
CRingEngine::DoCalibXYZ(): Cycle 50 - OV = 0.0514205 SearchRange=(0.048,0.052).
CRingEngine::DoCalibXYZ(): Cycle 50 - OV = 0.0514205 actual SearchRange (0.048,0.052).
CRingEngine::DoCalibXYZ(): Cycle 50 - Calibration terminated.
        +---------------------------------------+
        +---------------------------------------+
        | Thu Jul 17 12:46:16 2003              |
        | Regulator Adjust                      |
        | X Gradient results:                   |
        +---------------------------------------+
        | Current curve description:            |
        | t_START =    0.5760 msec              |
        | t_STOP  =    0.9472 msec              |
        | Dt_RAMP =    0.3712 msec              |
        | Y_OFFSET=  143.6800 ADC u.            |
        | Dt_MAX  =    0.4096 msec              |
        | Y_MAX   =  852.0000 ADC u.            |
        | Y_REG   =  817.3591 ADC u.            |
        | Dt_HWHM =    0.0563 msec              |
        | SF      =    0.0841 a.u.              |
        |                                       |
        | Dig. pot. values:                     |
        | [P,I,D]=[25,6,5]                      |
        |                                       |
        | Specifications:                       |
        | overshoot = 5.1420 % [5 +/- 0.2]      |
        |                                       |
        | Current Regulators for X gradient     |
        | ARE IN SPECIFICATION !                |
        +---------------------------------------+
        +---------------------------------------+
```

- Now the system performs the Phase Stability check. An error message is shown just in case of problem, otherwise the procedure goes on automatically. In case of Phase Stability problem perform the magnetic compensation procedure and repeat the ECC Tune
- The system performs a automatic check of the Phantom position, an error message is shown only in case of problem asking you to re-set the Phantom position and in which direction you have to move it
- The system performs the ECC calibration for every channel and shows the result as soon as they are available
- Wait for the end of calibration (1 hour) when the system completes the shown table like in the next figure. The values are automatically saved. Use the scroll bar to read all the values: they must be under specification (an asterisk put in evidence the not correct values)

Fig. 143: ECC Tune results



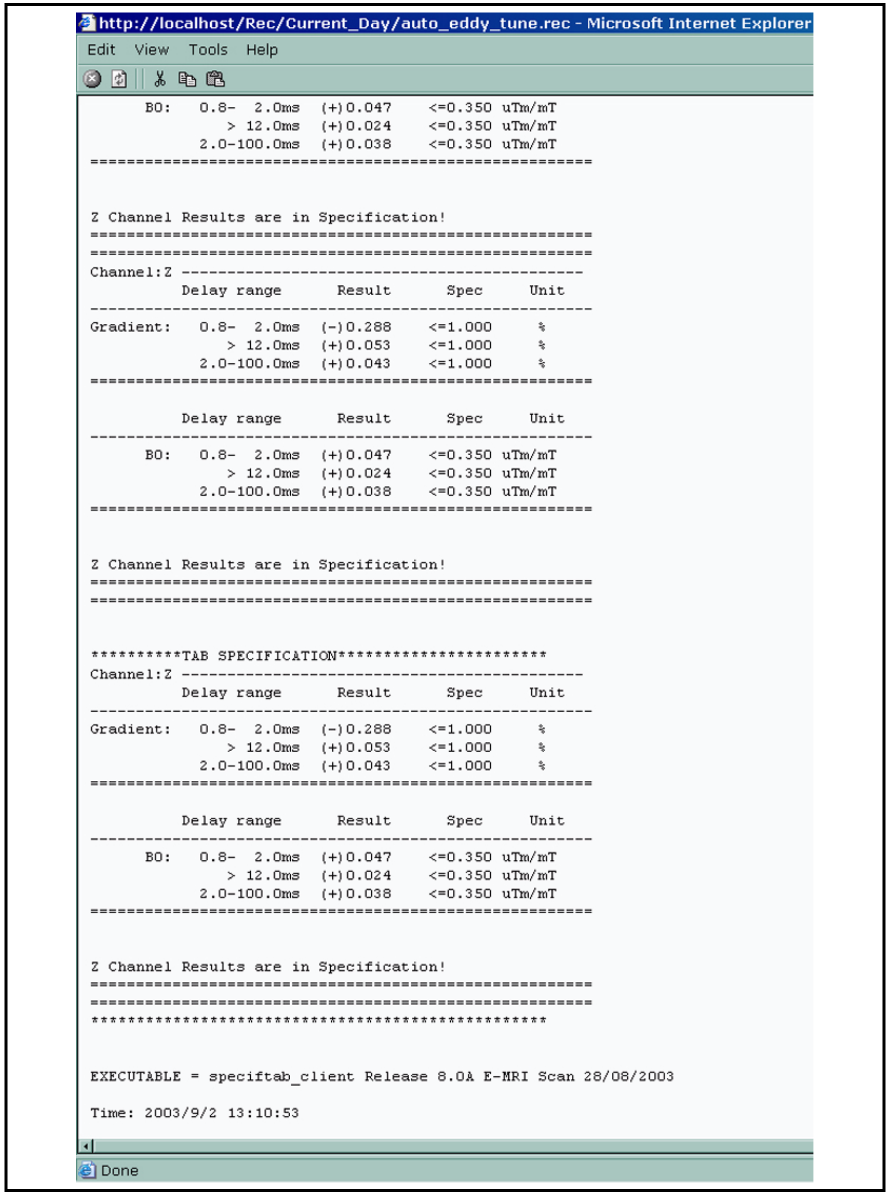
```
Channel:X ------------------------------------------------
          Delay range        Result       Spec      Unit
----------------------------------------------------------
Gradient:    0.8-   2.0ms   (-)0.214     <=1.000     %
                  > 12.0ms  (-)0.021     <=1.000     %
             2.0-100.0ms    (-)0.189     <=1.000     %
==========================================================

          Delay range        Result       Spec      Unit
----------------------------------------------------------
      B0:    0.8-   2.0ms   (+)0.133     <=0.350 uTm/mT
                  > 12.0ms  (-)0.073     <=0.350 uTm/mT
             2.0-100.0ms    (+)0.101     <=0.350 uTm/mT
==========================================================


X Channel Results are in Specification!
==========================================================
==========================================================
Channel:Y ------------------------------------------------
          Delay range        Result       Spec      Unit
----------------------------------------------------------
Gradient:    0.8-   2.0ms   (+)0.159     <=1.000     %
                  > 12.0ms  (-)0.052     <=1.000     %
             2.0-100.0ms    (+)0.071     <=1.000     %
==========================================================

          Delay range        Result       Spec      Unit
----------------------------------------------------------
      B0:    0.8-   2.0ms   (+)0.030     <=0.350 uTm/mT
                  > 12.0ms  (+)0.016     <=0.350 uTm/mT
             2.0-100.0ms    (+)0.013     <=0.350 uTm/mT
==========================================================


Y Channel Results are in Specification!
==========================================================
==========================================================
Channel:Z ------------------------------------------------
          Delay range        Result       Spec      Unit
----------------------------------------------------------
Gradient:    0.8-   2.0ms   (-)0.198     <=1.000     %
                  > 12.0ms  (+)0.056     <=1.000     %
             2.0-100.0ms    (+)0.093     <=1.000     %
==========================================================

          Delay range        Result       Spec      Unit
----------------------------------------------------------
      B0:    0.8-   2.0ms   (+)0.052     <=0.350 uTm/mT
                  > 12.0ms  (+)0.017     <=0.350 uTm/mT
             2.0-100.0ms    (+)0.017     <=0.350 uTm/mT
==========================================================


Z Channel Results are in Specification!
==========================================================
==========================================================
```

```
<3-20-7-1-20-106>
End of ECC Tune calibration. Check results
 against specifications.
```

```
        CoiCmdStart "r wscript ResetPredef.vbs predef.prd p_selall
        CoiCmdStart "r wscript CopyEddyDir.vbs Tune
        CoiCmdStart "Commit
        CoiCmdStart "lnb END_ECC_TUNE_CALIBR
        CoiShell_NOT  <3-20-7-1-20-106>End of ECC Tune calibration. Check results against specificati
        CoiChangeState "Captured"
        CoiScanEnd
 30: MS_IINe -> if 1 != 1 goto 40
 31: Getfile(Remote=%TMP_REC_FILE%, Local=.\Work\local\tmp.rec)
        GetFile  <3-38-7>nErrorCode=<3-38-7>
 35: MS_AddScanLogger(.\Work\local\tmp.rec)



2003/7/17 13:28:22 - e:\nmr\bin\releaseDbg\tarat.exe tar_field
    Rec file: 'freq_line.rec'.
Magnet frequency:
CTarField::CalcFreq():
        FirstPoint=0  LastPoint=2048
        MaxAbs=16339.7(pos=148).
        MaxRel=16339.7(pos=148).
FirstPoint=0  LastPoint=2048
CTarField::CalcDelta(): Freq=3.53342 Delta=-3
        original value = 7662746.
        calculated value = 7662743.


 40: Stop exitcode=0
        MSEnd
```

- Fill in the **Installation Quality Form** with the saved values
- It's possible to read the obtained values also selecting the file **auto_eddy_tune.rec**, then scroll the file to read the X, Y, Z and 4th channel values. The values of the last performed check are in the bottom part of the file. If this file is opened during the calibration the system will not refresh it: quit and re-open the file to refresh it

Fig. 144: auto_eddy_tune.rec

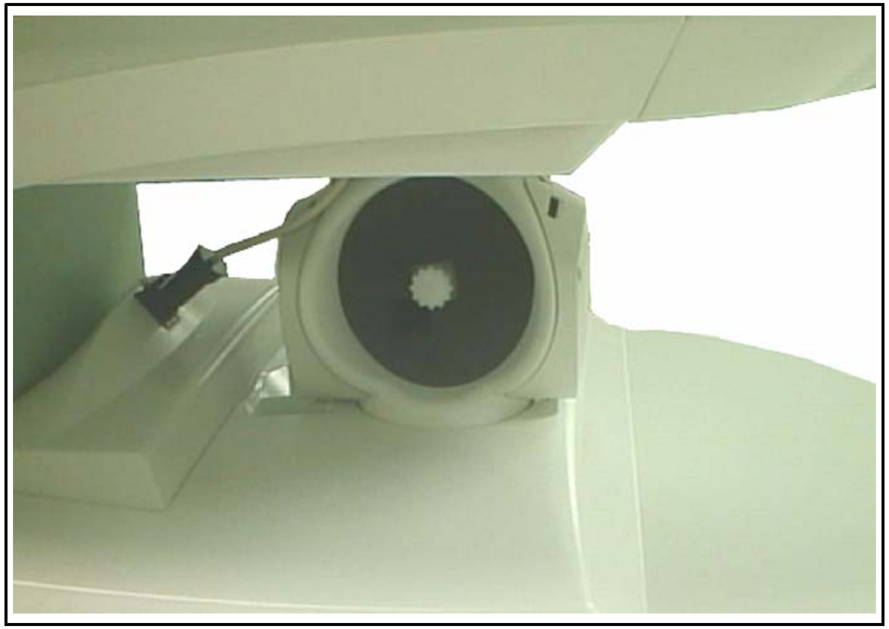

http://localhost/Rec/Current_Day/auto_eddy_tune.rec - Microsoft Internet Explorer
Edit View Tools Help
Done

```
      B0:    0.8-   2.0ms   (+)0.047     <=0.350 uTm/mT
                  > 12.0ms  (+)0.024     <=0.350 uTm/mT
             2.0-100.0ms    (+)0.038     <=0.350 uTm/mT
=======================================================


Z Channel Results are in Specification!
=======================================================
=======================================================
Channel:Z ---------------------------------------------
          Delay range       Result       Spec     Unit
-------------------------------------------------------
Gradient:    0.8-   2.0ms   (-)0.288     <=1.000     %
                  > 12.0ms  (+)0.053     <=1.000     %
             2.0-100.0ms    (+)0.043     <=1.000     %
=======================================================

          Delay range       Result       Spec     Unit
-------------------------------------------------------
      B0:    0.8-   2.0ms   (+)0.047     <=0.350 uTm/mT
                  > 12.0ms  (+)0.024     <=0.350 uTm/mT
             2.0-100.0ms    (+)0.038     <=0.350 uTm/mT
=======================================================


Z Channel Results are in Specification!
=======================================================
=======================================================


*********TAB SPECIFICATION*********************
Channel:Z ---------------------------------------------
          Delay range       Result       Spec     Unit
-------------------------------------------------------
Gradient:    0.8-   2.0ms   (-)0.288     <=1.000     %
                  > 12.0ms  (+)0.053     <=1.000     %
             2.0-100.0ms    (+)0.043     <=1.000     %
=======================================================

          Delay range       Result       Spec     Unit
-------------------------------------------------------
      B0:    0.8-   2.0ms   (+)0.047     <=0.350 uTm/mT
                  > 12.0ms  (+)0.024     <=0.350 uTm/mT
             2.0-100.0ms    (+)0.038     <=0.350 uTm/mT
=======================================================


Z Channel Results are in Specification!
=======================================================
=======================================================
***************************************************


EXECUTABLE = speciftab_client Release 8.0A E-MRI Scan 28/08/2003

Time: 2003/9/2 13:10:53
```

Gradient delay

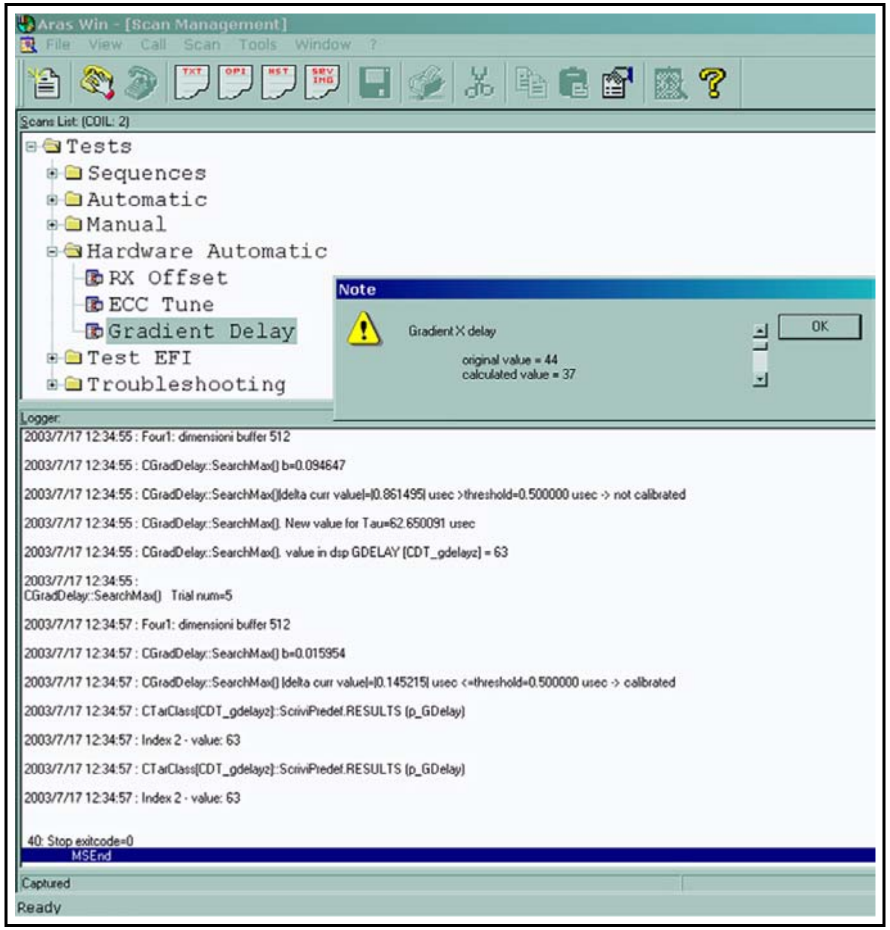
- Insert into the Knee Coil 2 the ghosting phantom (in central position) using its support. Like shown in the next figure

Fig. 145: Ghosting Phantom position



- Perform the Gradient delay calibration selecting, under ARAS, **<Test> <HW Automatic> <Gradient Delay> <Exec>**. The system automatically finds and save the best G-Readout value for every sequence

Fig. 146: Gradient Delay automatic calibration



Note

Gradient X delay

original value = 44
calculated value = 37

```
2003/7/17 12:34:55 : Four1: dimensioni buffer 512

2003/7/17 12:34:55 : CGradDelay::SearchMax() b=0.094647

2003/7/17 12:34:55 : CGradDelay::SearchMax()|delta curr value|=|0.861495| usec >threshold=0.500000 usec -> not calibrated

2003/7/17 12:34:55 : CGradDelay::SearchMax(). New value for Tau=62.650091 usec

2003/7/17 12:34:55 : CGradDelay::SearchMax(). value in dsp GDELAY [CDT_gdelayz] = 63

2003/7/17 12:34:55 :
CGradDelay::SearchMax()   Trial num=5

2003/7/17 12:34:57 : Four1: dimensioni buffer 512

2003/7/17 12:34:57 : CGradDelay::SearchMax() b=0.015954

2003/7/17 12:34:57 : CGradDelay::SearchMax() |delta curr value|=|0.145215| usec <=threshold=0.500000 usec -> calibrated

2003/7/17 12:34:57 : CTarClass[CDT_gdelayz]::ScriviPredef.RESULTS (p_GDelay)

2003/7/17 12:34:57 : Index 2 - value: 63

2003/7/17 12:34:57 : CTarClass[CDT_gdelayz]::ScriviPredef.RESULTS (p_GDelay)

2003/7/17 12:34:57 : Index 2 - value: 63


 40: Stop exitcode=0
        MSEnd
```

- Fill in the **Installation Quality Form** with the saved values
- The corresponding rec file is called **gdelay.rec**

Gain Gradient Calibration

Necessary Tools

– Geometrical Phantom and its supports

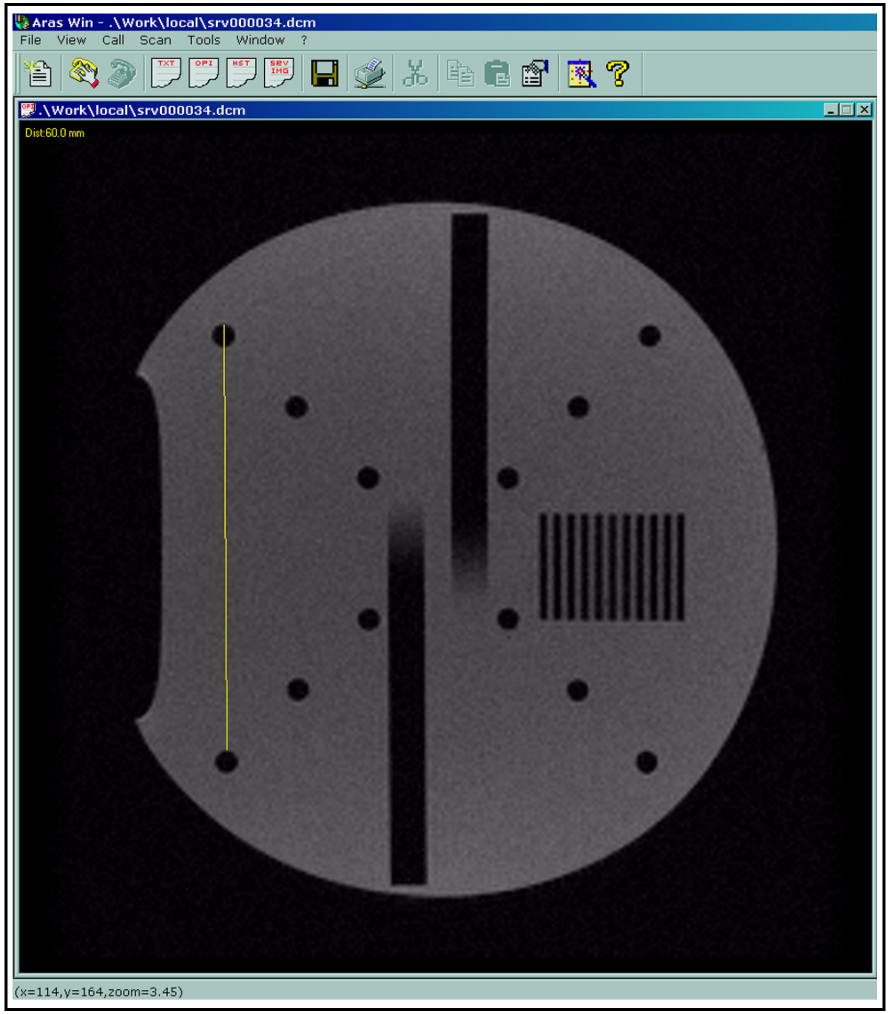
Operations

By adjusting the gradient gains, it is possible to change the relationship between actual dimensions and those rendered by the images. For this purpose, the geometrical phantom has been fitted with pins at a pre-set distance. After checking their distance in the medium and largest square (40 and 60 mm), modify the gains until the error obtained is below a tenth of a millimeter.

- Put the Geometrical Phantom in Axial position inside the Knee Coil 2 and perform one scout selecting the district “**Other”**
- Under OPI click on **<Protocol list>** and select the sequence **X GRADIENT GAIN CALIBRATION**
- When the images is obtained, load it from ARAS then select the **<Distance>** or **<Profile>** tools
- Measure the **vertical** distance between the pins 40 and 60 mm and record it in the form (the image is Axial but rotated 90° CCW)
- If the measurement has an error exceeding 1% of the ideal value, adjust the gain of the X gradient. Under Internet Exploring select the **<Hardware Configuration>** page then change the **Linear Gain X** increasing or decreasing its value in according if the measured distance is smaller or bigger than the ideal one then save it. One digital step means between 0.2 and 0.4 mm (increase it to increase the distance and vice-versa)
- Repeat the measurements till to reach the specification

NOTICE	The reference values for the pins at 40 mm are: 39.6 mm ÷ 40.4 mm The reference values for the pins at 60 mm are: 59.4 mm ÷ 60.6 mm

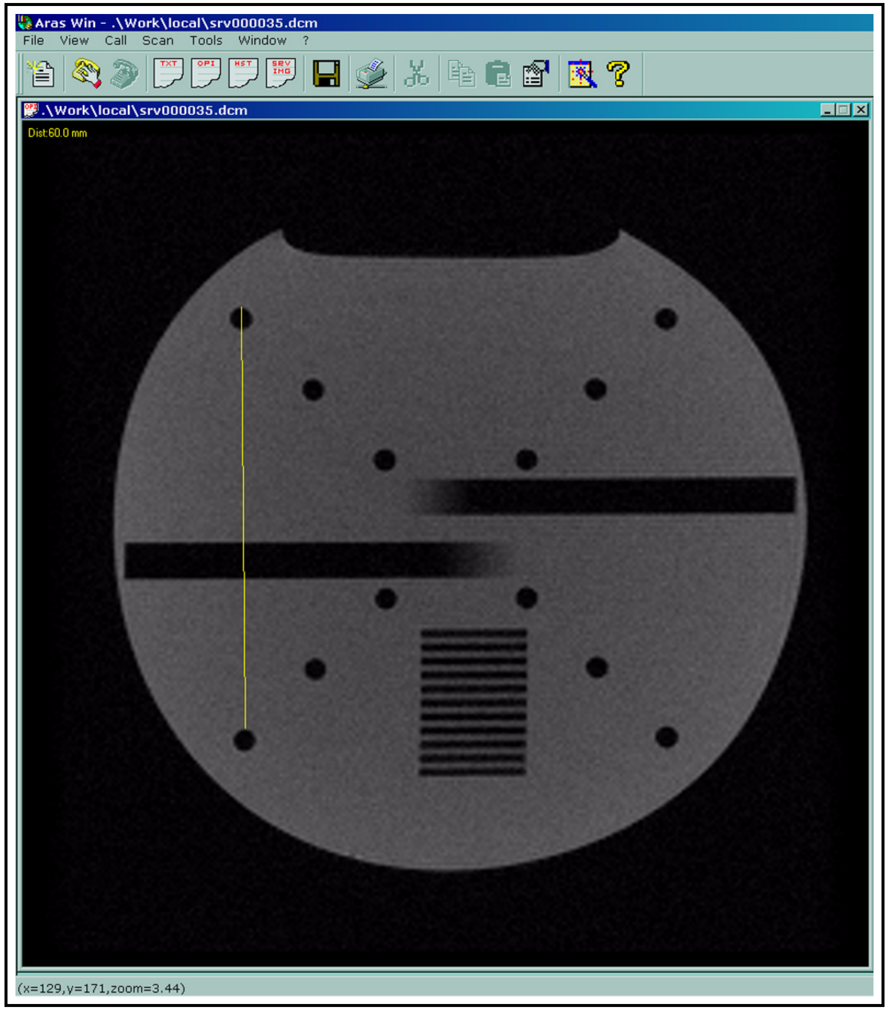
Fig. 147: X measurement


Aras Win - .\Work\local\srv000034.dcm
File
View
Call
Scan
Tools
Window
?
.\Work\local\srv000034.dcm
Dist:60.0 mm
(x=114,y=164,zoom=3.45)

- Keep the phantom in the Axial position and acquire the sequence **Y GRADIENT GAIN CALIBRATION**

- Measure the **vertical** distance between the pins 40 and 60 mm and record it in the form

Fig. 148: Y measurement


Aras Win - .\Work\local\srv000035.dcm
File
View
Call
Scan
Tools
Window
?
TXT
OPI
HST
SRV IMG
.\Work\local\srv000035.dcm

Dist:60.0 mm

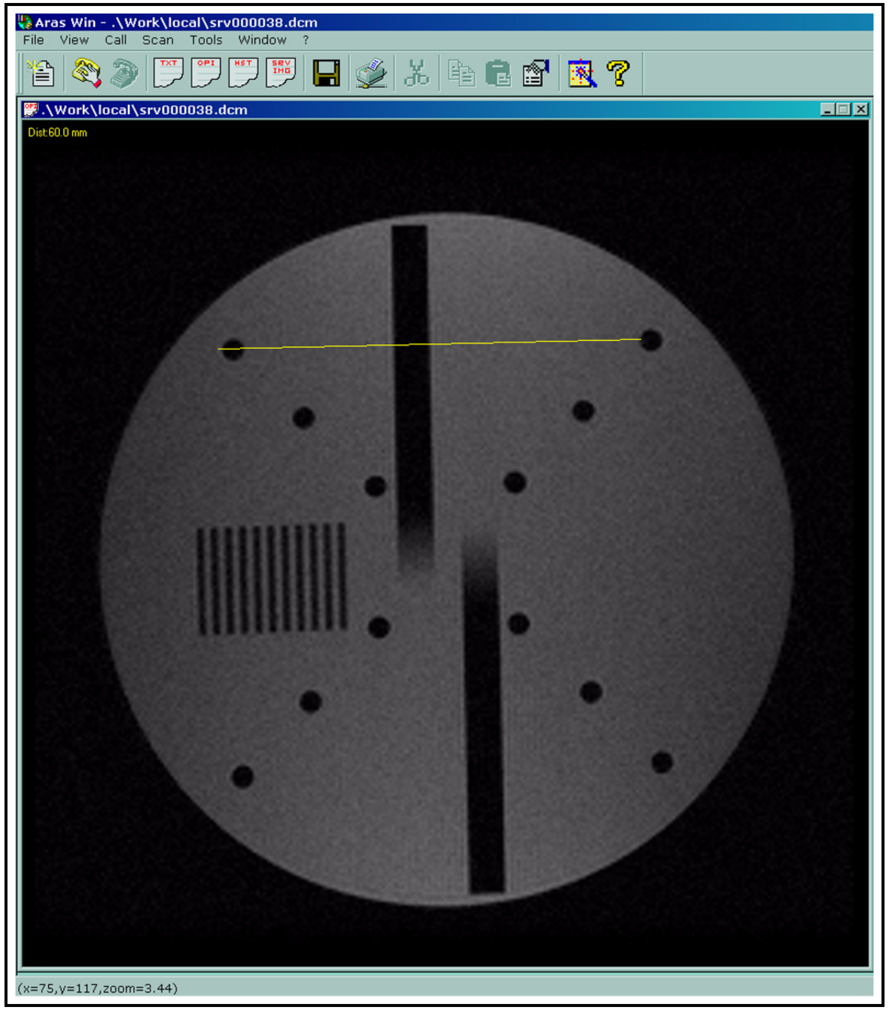
(x=129,y=171,zoom=3.44)

- If the measurement has an error exceeding 1% of the ideal value, adjust the gain of the Y gradient. Under Internet Exploring select the **<Hardware Configuration>** page then change the **Linear Gain Y** increasing or decreasing its value in according if the measured distance is smaller or bigger than the ideal one then save it. One digital step means between 0.2 and 0.4 mm (increase it to increase the distance and vice-versa)
- Repeat the measurements till to reach the specification

NOTICE	The reference values for the pins at 40 mm are: 39.6 mm ÷ 40.4 mm The reference values for the pins at 60 mm are: 59.4 mm ÷ 60.6 mm

- Place, the phantom in Coronal position, using the suitable support, and acquire the sequence: **4C__GRZ_GAIN: Z GRADIENT GAIN CALIBRATION**
- Select **<Service/Measurements>** and click on **<Profiles>**
- Display the reconstructed image in format 1. Zoom in if necessary
- Measure the **horizontal** distance between the pins 40 and 60 mm and record it in the form
- If the measurement has an error exceeding 1% of the ideal value, adjust the gain of the Z gradient. Under Internet Exploring select the **<Hardware Configuration>** page then change the **Linear Gain Z** increasing or decreasing its value in according if the measured distance is smaller or bigger than the ideal one then save it. One digital step means between 0.2 and 0.4 mm (increase it to increase the distance and vice-versa)
- Repeat the measurements till to reach the specification

Fig. 149: Z measurement


Aras Win - .\Work\local\srv000038.dcm
File View Call Scan Tools Window ?
TXT
OPI
HST
SRV IMG
.\Work\local\srv000038.dcm

Dist:60.0 mm

(x=75,y=117,zoom=3.44)

NOTICE

The reference values for the pins at 40 mm are: 39.6 mm ÷ 40.4 mm

The reference values for the pins at 60 mm are: 59.4 mm ÷ 60.6 mm

- Fill in the **Installation Quality Form** with the saved values

Gradient Offset Calibration

Necessary Tools

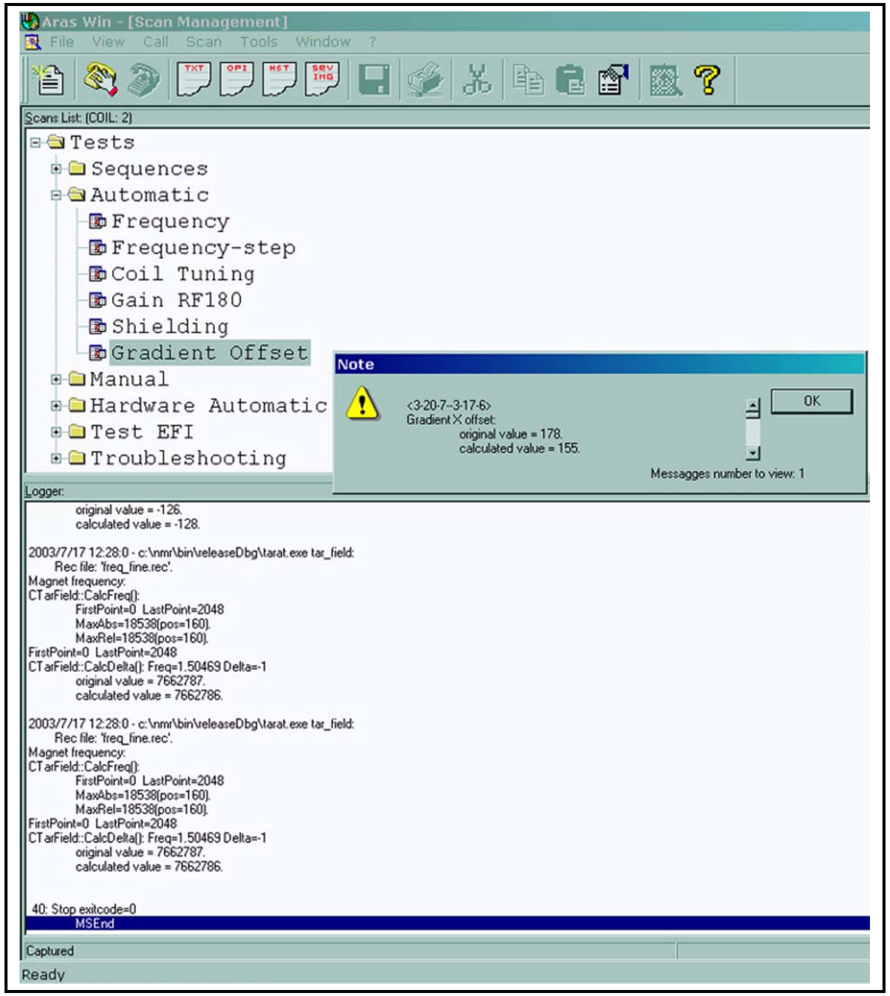
– Small Spherical phantom and its support

Operations

NOTICE Perform this calibration or the Manual Homogeneity calibration

- Place the small spherical phantom into the Knee coil 2 and perform a Scout selecting the district **<Other>** and the bed patient position **<A>**
- Inside ARAS, select **<Test> <Automatic> <Gradient Offset> <Exec>**, the system will calibrate and save the gradient offsets and then will show the a correct calibration message

Fig. 150: System message



```
<3-20-7--3-17-6>
Gradient X offset:
        original value = 178.
        calculated value = 155.
```

```
        original value = -126.
        calculated value = -128.

2003/7/17 12:28:0 - c:\nmr\bin\releaseDbg\tarat.exe tar_field:
    Rec file: 'freq_fine.rec'.
Magnet frequency:
CTarField::CalcFreq():
        FirstPoint=0  LastPoint=2048
        MaxAbs=18538(pos=160).
        MaxRel=18538(pos=160).
FirstPoint=0  LastPoint=2048
CTarField::CalcDelta(): Freq=1.50469 Delta=-1
        original value = 7662787.
        calculated value = 7662786.

2003/7/17 12:28:0 - c:\nmr\bin\releaseDbg\tarat.exe tar_field:
    Rec file: 'freq_fine.rec'.
Magnet frequency:
CTarField::CalcFreq():
        FirstPoint=0  LastPoint=2048
        MaxAbs=18538(pos=160).
        MaxRel=18538(pos=160).
FirstPoint=0  LastPoint=2048
CTarField::CalcDelta(): Freq=1.50469 Delta=-1
        original value = 7662787.
        calculated value = 7662786.


 40: Stop exitcode=0
        MSEnd
```

- The corresponding rec file is called **offgr.rec**
- Fill in the **Installation Quality Form** with the saved values

Gradient coils replacement

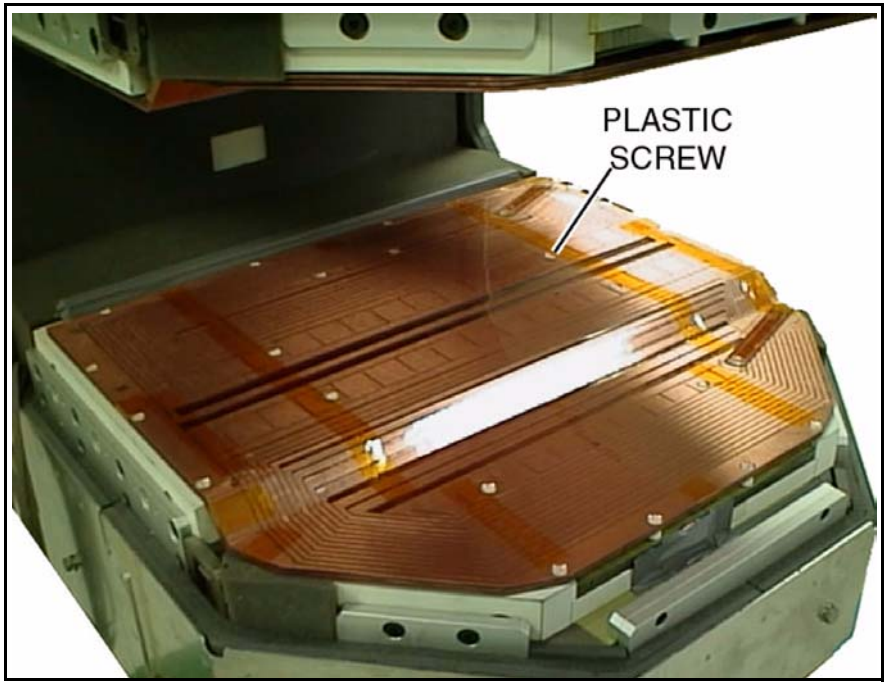
Remove the gradients if you need to check or change them or to gain access to the shimming plates.

These are composed of one lower and one upper gradient plate.

Sequence operation

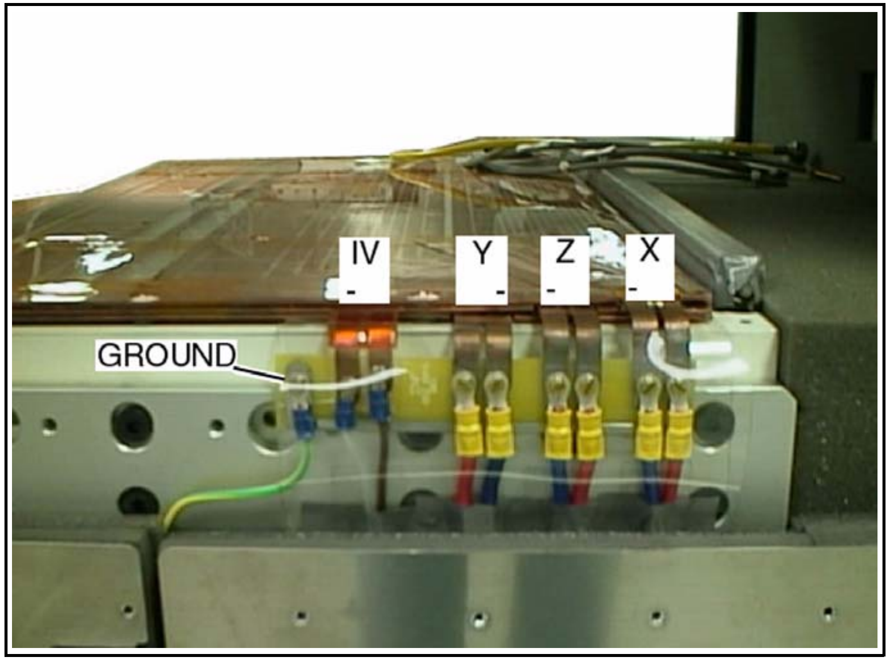
- Disable the SGRA (remove the rear power plug)
- Follow the procedure explained in the RF chapter
- When the Gantry is removed, take out all the plastic screws

Fig. 151: *Lower gradient coils (in white the plastic screws)*



- The cables in the lower gradient cable connection are as follows, from left to right:
  - The yellow and green cable is the ground cable
  - The fourth channel has the white cable (negative) and the blue cable (connected to the upper fourth channel coil)
  - Y gradient has the red cable (connected to the Y upper coil) and the blue cable (negative)
  - Z gradient has the blue cable (negative) and the red cable (connected the Z upper coil)
  - X gradient has the blue cable (negative) and the red cable (connected the X upper coil)

Fig. 152: *Lower gradient cables connection*



- From left to right, the upper gradient connecting cables are as follows:
  - – The yellow and green cable is the ground cable
  - – The fourth channel has the brown cable (connected to the lower fourth channel coil) and the black cable (positive)
  - – Y gradient has the red cable (connected to the Y lower coil) and the brown cable (positive)
  - – Z gradient has the brown cable (negative) and the red cable (connected the Z lower coil)
  - – X gradient has the brown cable (negative) and the red cable (connected the X lower coil)

Fig. 153: Upper gradient cables connection

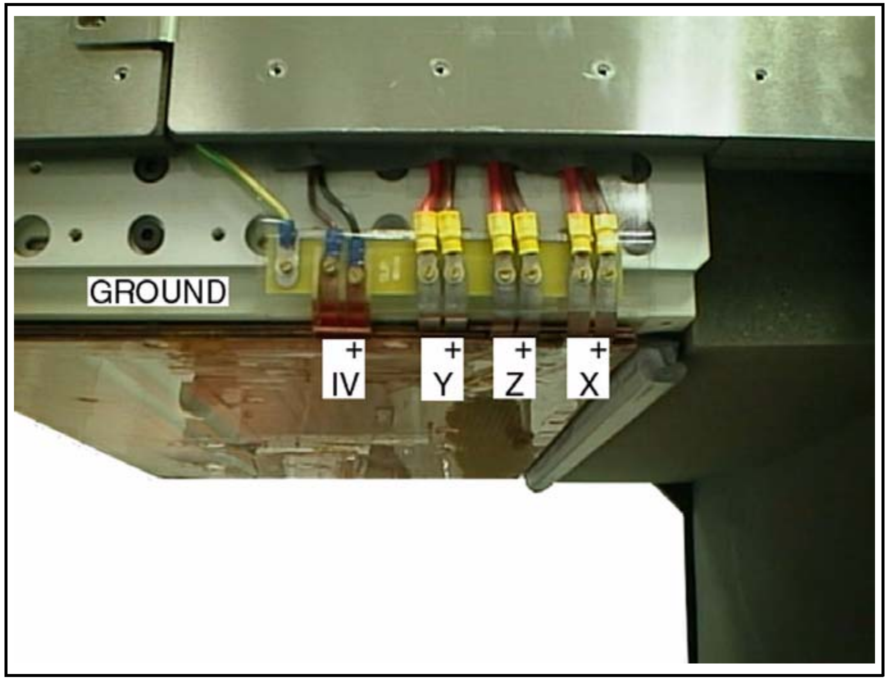
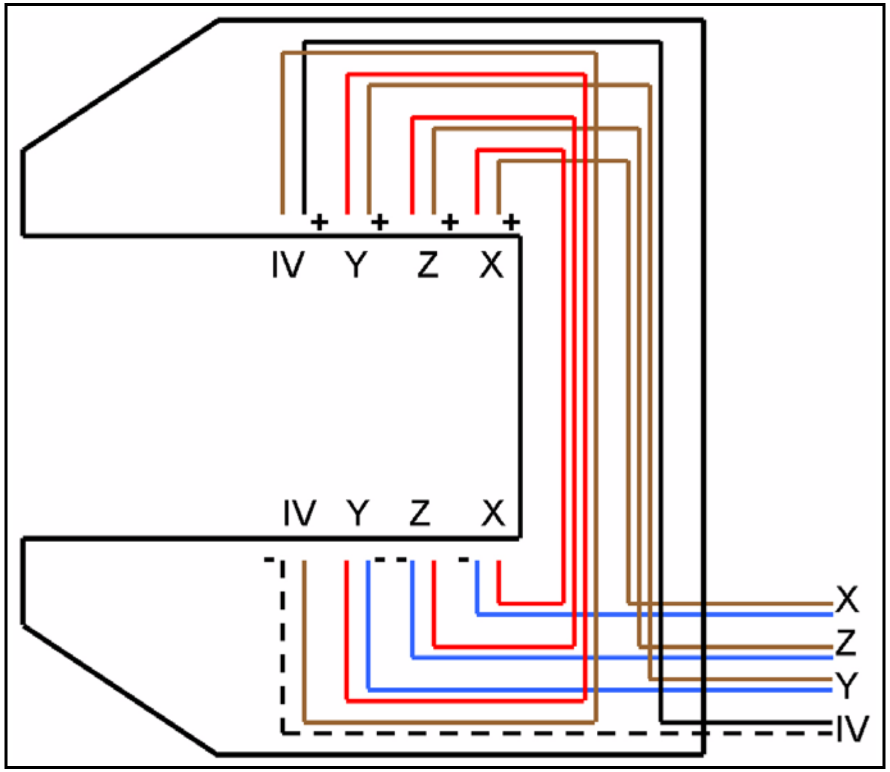


Fig. 154: Gradient cables connection scheme



- The gradient coils are separated one from the others by plastic plates and have their own layout. One of the gradient coils is shown in the following figure
- Follow the procedure in reverse order to re-place gradient coils and gantry

Test and adjustment table

MODULE	TEST	ADJUSTMENT
SGRA	Under ARAS, select <**Test**> <**Trouble Shoot.**> <**System check**> and see if the output signals from the SGRA (gradients) are present. Perform the **Image Orientation Test** and the **4th Channel Polarity Check** to be sure about the correct Gradient Cables connection	Check the gradient rise time and the geometrical distortion test for every channel, then calibrate the system (**ECC Tune, Gradient Delay, Gradient Gain Calibration and Gradient Offset Calibration**)
Gradient coil	Under ARAS, select <**Test**> < **Trouble Shoot.**> <**System check**> and see if the output signals from the SGRA (gradients) are present. Perform the **Image Orientation Test** and the **4th Channel Polarity Check** to be sure about the correct Gradient Cables connection	Check the gradient rise time and the geometrical distortion test for every channel, then calibrate the system (**ECC Tune, Gradient Delay, Gradient Gain Calibration and Gradient Offset Calibration**)

Part 10 Magnet

Trouble Shooting Strategy

You will find test strategies, procedures and repair instructions encompassing the complete Magnet system in this section.

For more information refer to the Functional Description manual Magnet chapter.

⚠**WARNING** **Make sure you use only non ferro magnetic tools near the magnet. Do not place any other ferro magnetic objects near the magnet (e.g. the metal supports used for the Magnet transportation).**

Be careful that screws, etc. or other foreign metallic bodies do not fall into the equipment, because they could cause a short circuit.

Be careful with the cables coming from the unit: they should be positioned so that they do not represent an obstacle otherwise they could break, causing damage to the unit and could be hazardous for both the patient and operator.

Procedure

Thermal Control

The magnet must always be at the correct temperature, to achieve this result three dedicated modules have been fitted to the system.

The first one is the MTCM module, installed inside the Signal Box present into the Electronic unit, it has to manage the temperature values coming from the Magnet and drive the TPM (installed inside the Electronic Unit as well) that sends power to the heaters fitted into the Magnet structure. The last board is the NTC that is installed on the right side of the magnet; a small-dedicated panel used to check it is installed on the magnet's side cover. Resistors are fitted to the board and their values are calculated by taking note of the value of the thermal sensors in the magnet in order the make all the Magnet exactly equal one to the other.

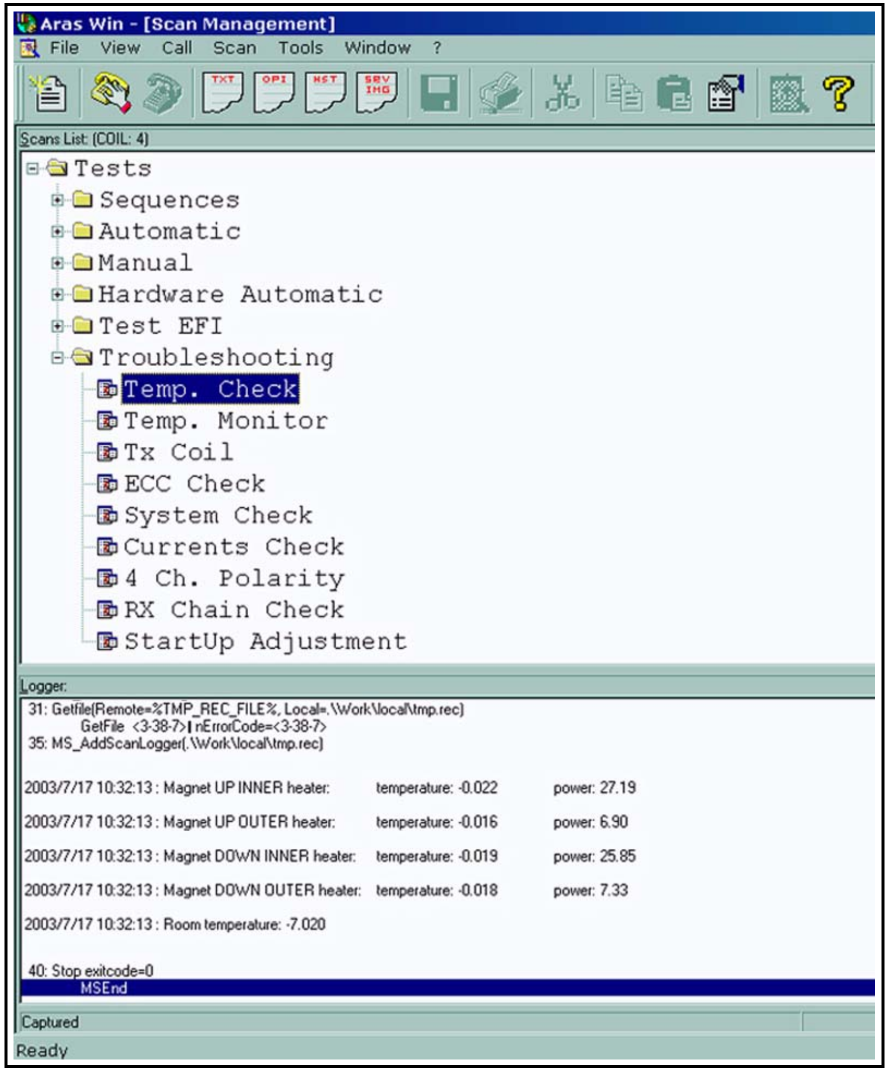
This means that every magnet has its own NTC board. It collects the data coming from the temperature sensors and receive the power for the heaters.

To check if the magnet is at the correct temperature, perform the automatic temperature test present under ARAS, select **<Test> <Troubleshoot.> <Temp. Check>**. Remember to insert a coil before to perform this test.

This test will give some information shown in the following figure.

But if you have to visualize the temperature in real time to evaluate any kind of temperature instability, another test is available called system monitor.

Fig. 155: Automatic temperature test



```
 31: Getfile(Remote=%TMP_REC_FILE%, Local=.\Work\local\tmp.rec)
         GetFile  <3-38-7>| nErrorCode=<3-38-7>
 35: MS_AddScanLogger(.\Work\local\tmp.rec)


2003/7/17 10:32:13 : Magnet UP INNER heater:      temperature: -0.022        power: 27.19

2003/7/17 10:32:13 : Magnet UP OUTER heater:      temperature: -0.016        power: 6.90

2003/7/17 10:32:13 : Magnet DOWN INNER heater:    temperature: -0.019        power: 25.85

2003/7/17 10:32:13 : Magnet DOWN OUTER heater:    temperature: -0.018        power: 7.33

2003/7/17 10:32:13 : Room temperature: -7.020


 40: Stop exitcode=0
         MSEnd
```

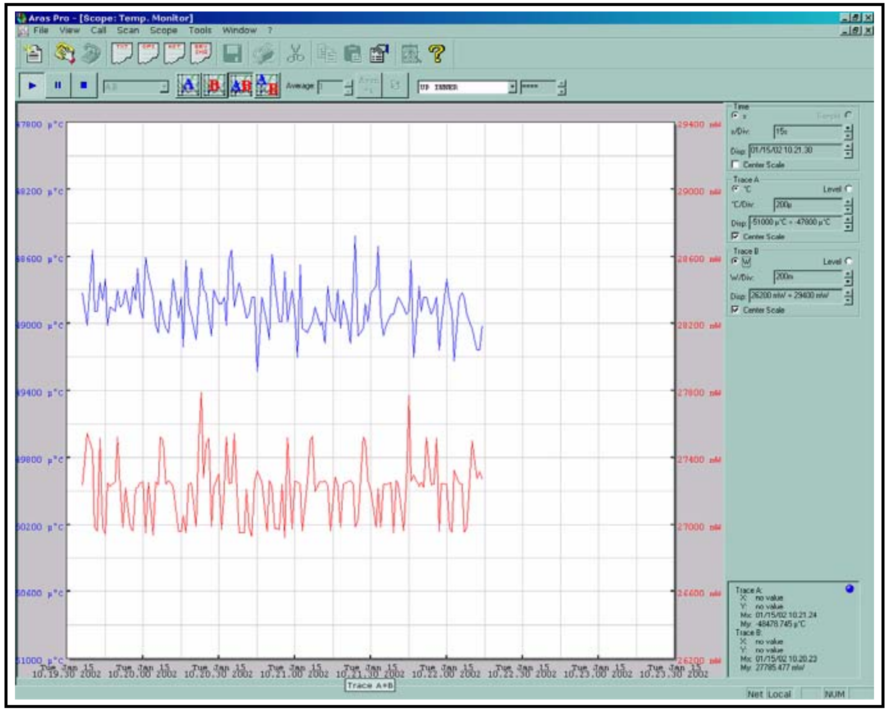
Temp. Monitor

Operations

- Online analysis is made available by pressing the **<Temp Monitor>** button in the menu **Under ARAS, select - <Test> - <Troubleshoot.>**: it is thus possible to store the data items of the selected logical channel and observe their time evolution at the same time
- Each logical channel is associated to a historical file that belongs to **<Temp. Monitor>** category (in this way distinguished from the files resulting from data acquisition in **<System History>** and **<Stress>** modes)
- The time scale zero is defined as the moment at which the measurement session starts. Data visualization and analysis can be performed on only one screen at a time: once a new screen is available, the previous one cannot be recovered
- The minimum time resolution is 1 s (in accordance with the available divisions on time scale in the **<RecFilePlot>** application). This value does not lead to severe analysis limitations, since time variations in the monitored quantities always take place at longer intervals
- The Pause function operates in this context on the data on the current screen which is frozen when Pause is activated
- Enter the service menu and click on **<Test> <Trouble Shoot.>** and **<Temp. Monitor>** button
- Use the arrow to set the logical channels 0, 1, 2, 3 to display the parameters on the four sides of the magnet (inner and outer, upper and lower)
- Click on the **<Channel A>** icon to display only the temperature error or on the **<Channel B>** icon to display the power output to the heaters, or on the **<Dual>** button to display them together
- Press **<Scale Div.>** to set the correct value of the scale on the Y axis (for example: 1 m °C for the temperature error and 15 Watt for the power output to the heaters)

- Then, with the mouse cursor, click on the signal trace to obtain some information about it in the information window

Fig. 156: Temp Monitor



Time
● s ○ Sample
s/Div: 15s
Disp: 01/15/02 10.21.30
☐ Center Scale

Trace A
● °C ○ Level
°C/Div: 200µ
Disp: 51000 µ°C ÷ 47800 µ°C
☑ Center Scale

Trace B
● W ○ Level
W/Div: 200m
Disp: 26200 mW ÷ 29400 mW
☑ Center Scale

Trace A:
X: no value
Y: no value
Mx: 01/15/02 10.21.24
My: -48478.745 µ°C
Trace B:
X: no value
Y: no value
Mx: 01/15/02 10.20.23
My: 27785.477 mW

NOTICE	The system monitor test visualizes a flat line if the temperature error is higher then 0.7 °C with respect to the ideal value

---

MTCM can disable SGRA by sending on the GROFF cable, connected to the ENABLE of SGRA. Its function is to protect the gantry: if the temperature on at least one side of the magnet is higher than 0.5° C compared with the normal magnet operating temperature or if the magnet temperature is too low, it switches the heaters and SGRA off.

Logical channels 0, 1, 2 and 3 are used to visualize the situation of the thermal control system, which includes the MTCM module, heaters and thermal sensors (NTC) located at the four sides inside the magnet, as well as the thermal insulation structure of the magnet itself.

Specifically, channel 0 monitors the **<UP INNER>**, channel 1 **<DOWN OUTER>**, channel 2 **<DOWN INNER>** and channel 3 **<UP OUTER>**. Each channel displays the power output to the heaters (red trace) and the temperature error detected by the two sensors (blue trace) located on the side being monitored.

No value may be changed since the thermal subsystem is independent from the personal computer (it also works when the computer is off).

It is only possible to act on the visualization commands (**<Scale Div.>, <Res. Div.>, <Displacement>, <Dual>** and the icons **<Channel A>** and **<Channel B>**).

If you click on the **<Channel A>** icon, the “*Diascope*” allows you to see the temperature error, so that you must only set the correct scale of visualization in m °C on the Y-axis.

If you select the **<Channel B>** icon, the “*Diascope*” displays the power output to the heaters, so that you must only set the right scale of visualization in Watts on the Y-axis.

Instead, if you click on the **<Dual>** button, the temperature error and the power output to the heaters are displayed together. The following figure shows these couples of magnet UP INNER data (Channel 0) after about four minutes of acquisition.

If the behavior is correct, we should be able to see straight lines that either do not change in time or change very slowly.

As for the numerical values, the temperature error must have an absolute value smaller than a few m °C and the power output to the heaters, always positive, must be lower than 50 Watt for the inner and 20 Watt for the outer channels

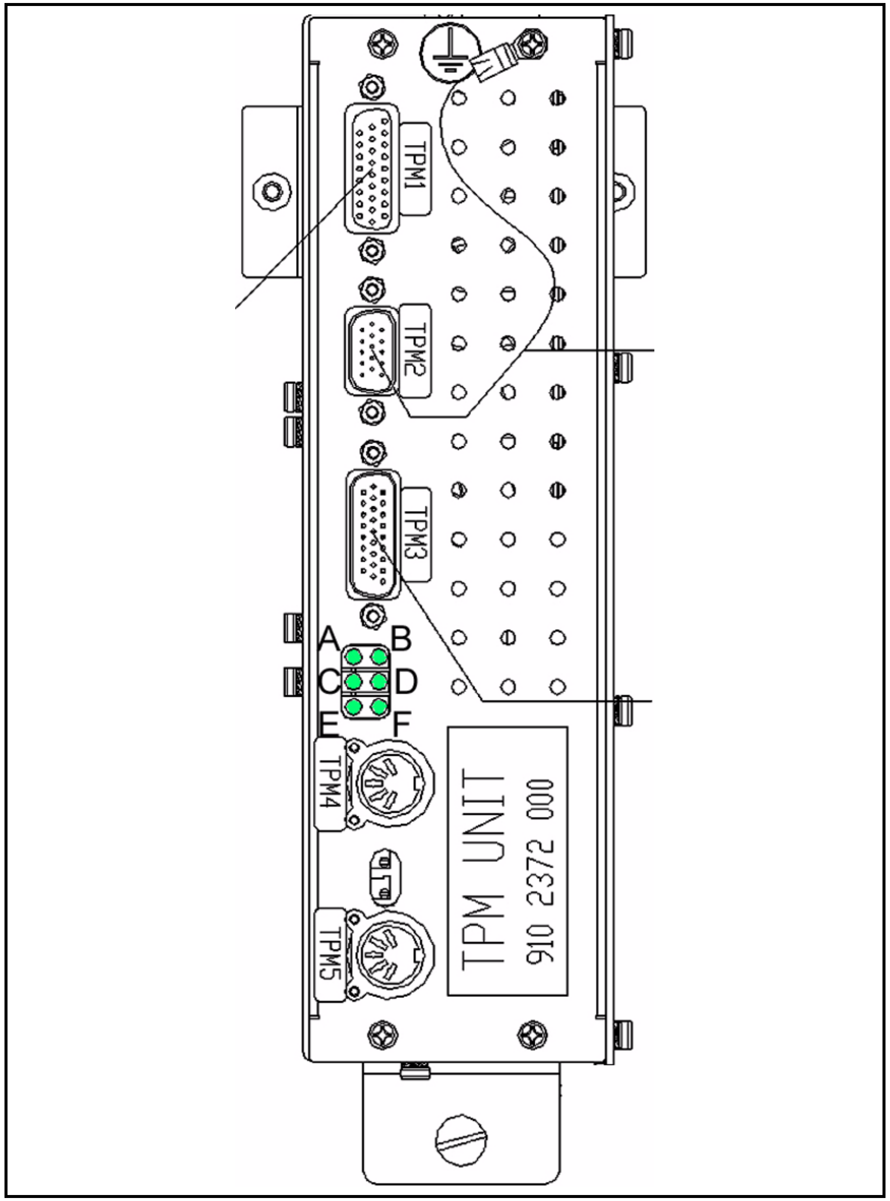
TPM Check

Open the Electronic Unit and check the TPM led status meaning:

Tab. 30: TPM led status meaning

Led	Normal	Error	Error Meaning
A	On	Off	
B	On	Off	
C	On	Off	
D	On	Off	
E	On	Off	Power to the heaters disabled
F	Blinking	On/Off	If on TPM not enabled, if off missing 5 V power supply inside the module

Fig. 157: TPM Module



Magnet Heaters and Sensors Check

It possible to measure the temperature on one magnet side, disconnecting the **FCTEMA** cable from the **NTC** board (Magnet right bottom side) and to measure the resistance between pins on the cable connector.

In the following table the resistor values of the heaters and sensors are shown.

Tab. 31: Heaters and sensors values

PIN	PIN	TYPE	MINIMUM VALUE	MAXIMUM VALUE
1	5	Heater up inner	45 Ω	55 Ω
2	5	Heater up outer	90 Ω	110 Ω
3	5	Heater down outer	90 Ω	110 Ω
4	5	Heater down inner	45 Ω	55 Ω
11	15	Sensor up inner	17 KΩ	20 KΩ
12	15	Sensor up outer	17 KΩ	20 KΩ
13	15	Sensor down outer	17 KΩ	20 KΩ
14	15	Sensor down inner	17 KΩ	20 KΩ

Environment temperature control

The **<Temp. Monitor>** environment makes it possible to also display external temperature. As a matter of fact, a particular probe is placed outside the System to check the external temperature, so that you can understand if something has changed in the external conditions.

The correct temperature value can be monitored, but you must probably change the scale on the Y-axis with the **<Scale Div.>** Button in °C and the **<Displacement>** button to improve the signal display. At this point, you can find out the exact external temperature value by clicking with the mouse on the signal trace.

Operations:

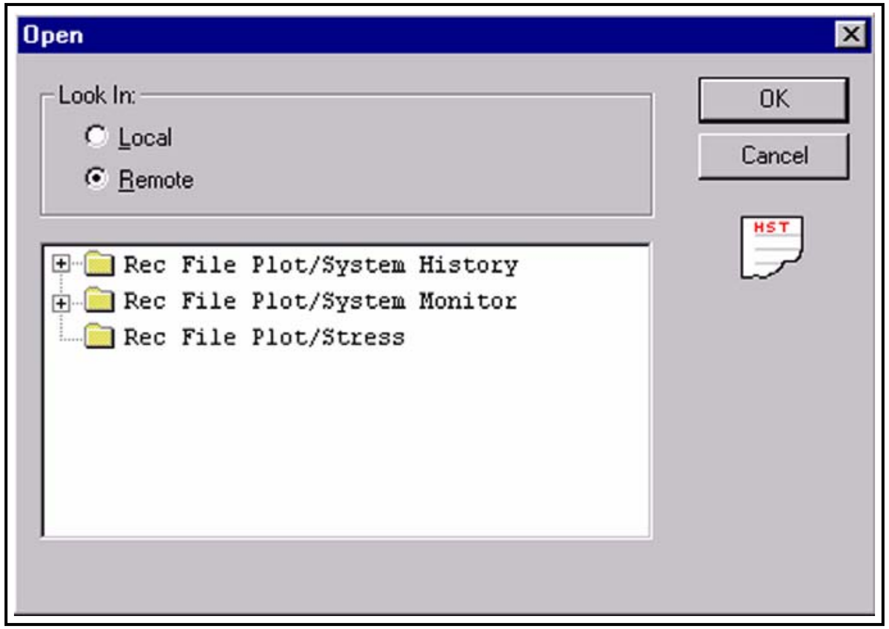
- Enter the service menu and click on **<Test> <Trouble Shoot.> <Temp Monitor>** button
- Use the arrow to set the logical channel 4 to display the external temperature
- Press <Scale Div.> to set the correct value for the scale on the Y-axis (usually 1 °C or 5 °C)
- Then, with the mouse cursor, click on the signal trace to obtain some information about it in the information window

NOTICE The above Sensor values are measured with the Magnet at around 20 °C. If the temperature is higher (ideal 36 °C) the values are different (generally around 13 KΩ)

It's possible to leave on the Temp Monitor (may be for the entire night) and then plot the acquired data.

Three folders are available under the **<Hist>** icon of the ARAS toolbar: **<RecFilePlot/System History>, <RecFilePlot/System Monitor>** and **<RecFilePlot/Stress>**. They make it possible to display the data items previously collected with one of the time ranges defined above. Here is a detailed list of the monitored quantities.

Fig. 158: History File Selection

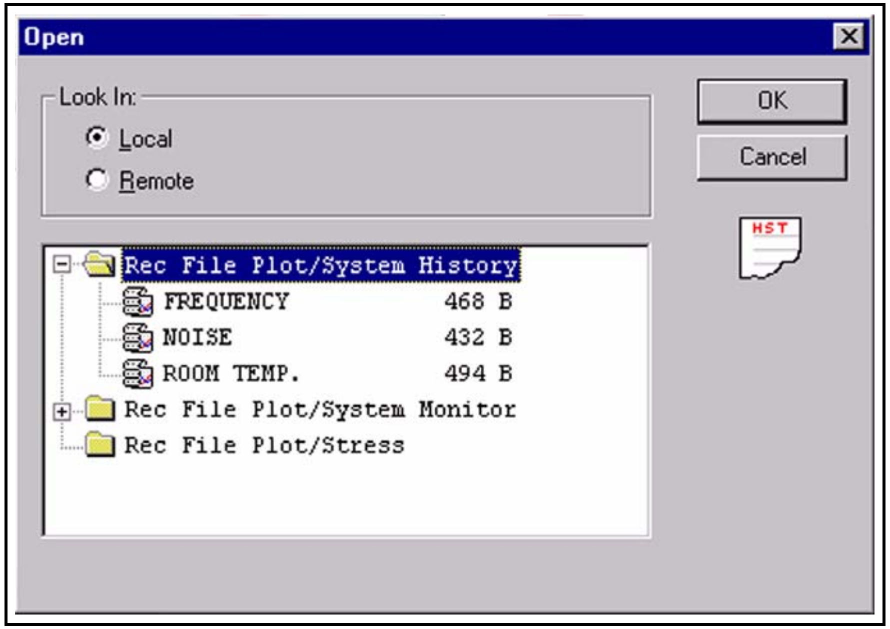


Look In: ○ Local ● Remote

System history

- Environment temperature
- Central precession (Larmor) frequency of static magnetic field
- Noise (average FFT)

Fig. 159: ***<RecFilePlot/System History>*** *folder*



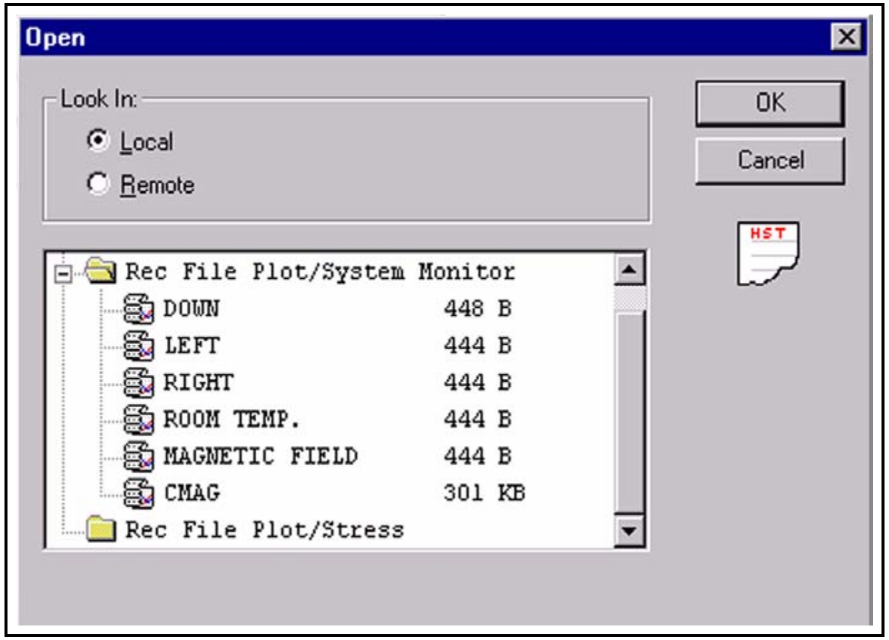
Look In: ● Local ○ Remote

System monitor

- Temp/Power UP INNER; DOWN OUTER; DOWN INNER and UP OUTER (Temperature/power associated with each of the four heaters)
- Environment temperature
- Magnetic field strength
- Magnetic field strength/Magnetic field strength in the gantry

(The last logical channel is fundamental also as a tool while performing magnetic compensation)

Fig. 160: ***<RecFilePlot/System Monitor>*** *folder*



```
Rec File Plot/System Monitor
    DOWN                448 B
    LEFT                444 B
    RIGHT               444 B
    ROOM TEMP.          444 B
    MAGNETIC FIELD      444 B
    CMAG                301 KB
Rec File Plot/Stress
```

Shimming check

Good homogeneity of the static field of the magnet is a necessary condition if you want to obtain good quality images. The shimming procedure made in the factory guarantees that magnetic field homogeneity is within specification when the magnet leaves the factory.

However, due to several factors (transportation, storage, etc.), the magnetic field may change, and the service operator might find that, on site, the homogeneity is not within specification anymore: this is due to the fact that some field coefficients (notably the second order coefficients) have increased.

The aim of this procedure is to detect and (if necessary) correct on site the second order coefficients of the magnetic field.

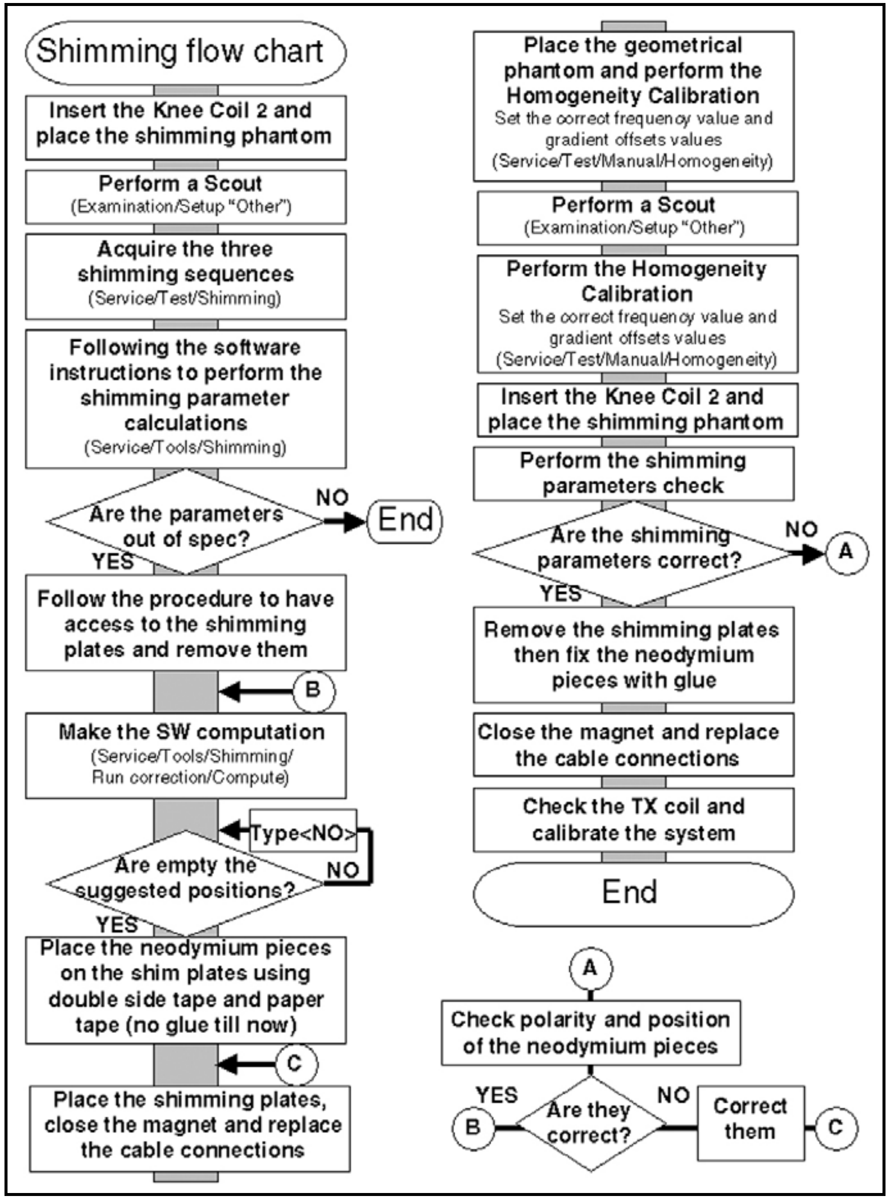


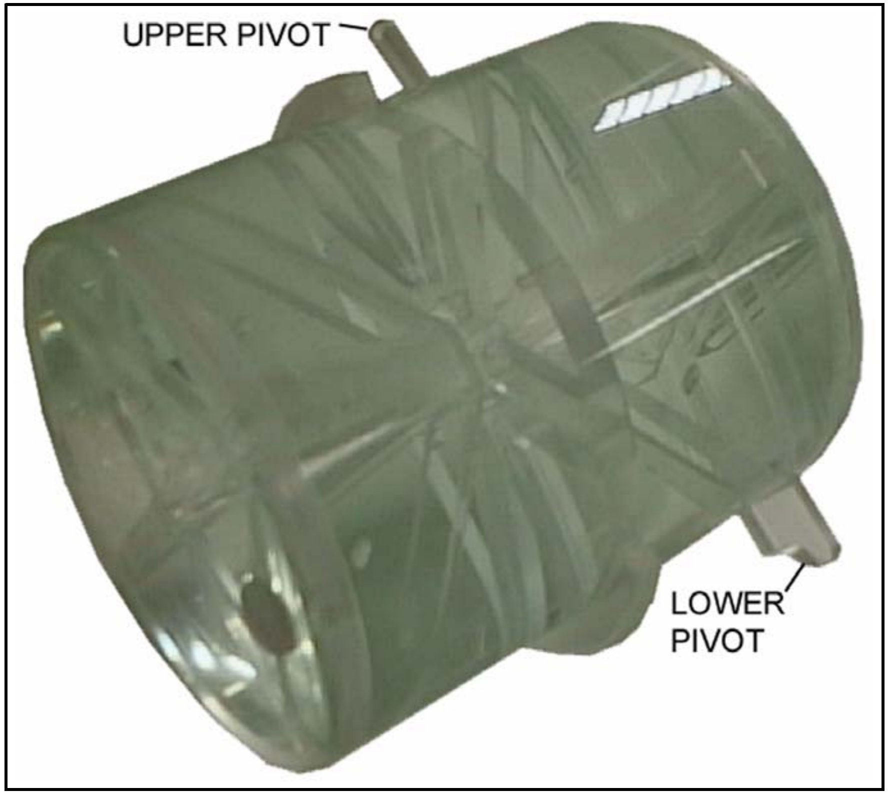
Fig. 161: Shimming Flowchart

Shimming flow chart
Insert the Knee Coil 2 and place the shimming phantom
Perform a Scout
(Examination/Setup "Other")
Acquire the three shimming sequences
(Service/Test/Shimming)
Following the software instructions to perform the shimming parameter calculations
(Service/Tools/Shimming)
Are the parameters out of spec?
NO
End
YES
Follow the procedure to have access to the shimming plates and remove them
B
Make the SW computation
(Service/Tools/Shimming/ Run correction/Compute)
Type<NO>
Are empty the suggested positions?
NO
YES
Place the neodymium pieces on the shim plates using double side tape and paper tape (no glue till now)
C
Place the shimming plates, close the magnet and replace the cable connections
Place the geometrical phantom and perform the Homogeneity Calibration
Set the correct frequency value and gradient offsets values
(Service/Test/Manual/Homogeneity)
Perform a Scout
(Examination/Setup "Other")
Perform the Homogeneity Calibration
Set the correct frequency value and gradient offsets values
(Service/Test/Manual/Homogeneity)
Insert the Knee Coil 2 and place the shimming phantom
Perform the shimming parameters check
Are the shimming parameters correct?
NO
A
YES
Remove the shimming plates then fix the neodymium pieces with glue
Close the magnet and replace the cable connections
Check the TX coil and calibrate the system
End
A
Check polarity and position of the neodymium pieces
YES
B
Are they correct?
NO
Correct them
C

Phantom positioning

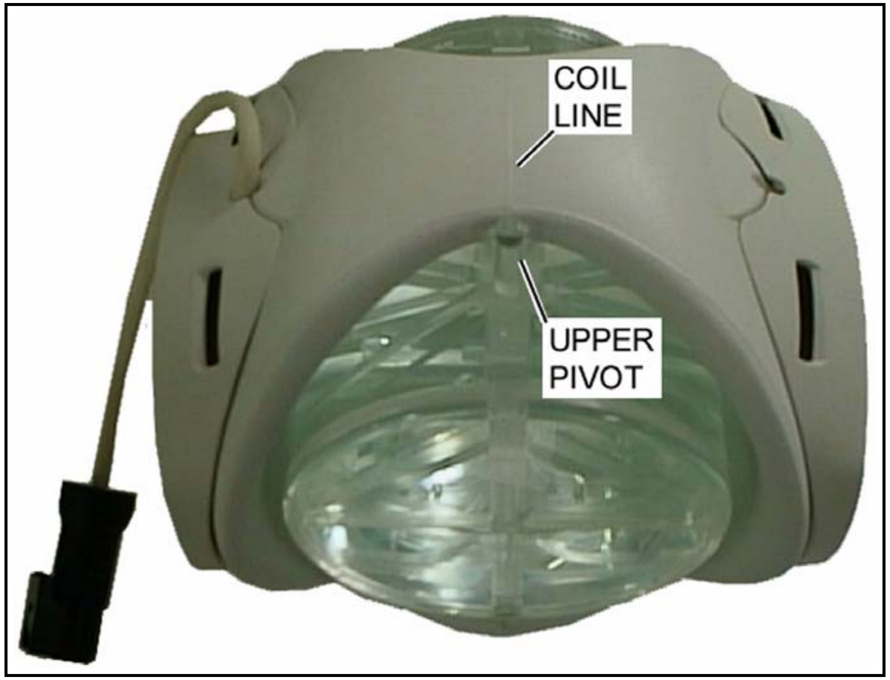
- Take the shimming phantom

Fig. 162: Shimming Phantom



- Insert the shimming phantom into the Knee Coil 2 taking care to insert the pivot at the top of the phantom perfectly along the coil line

Fig. 163: Shimming Phantom correctly inserted into the Knee Coil 2



- Check if the lower pivot of the phantom is also in contact with the coil

Fig. 164: Shimming Phantom correctly inserted into the Knee Coil 2

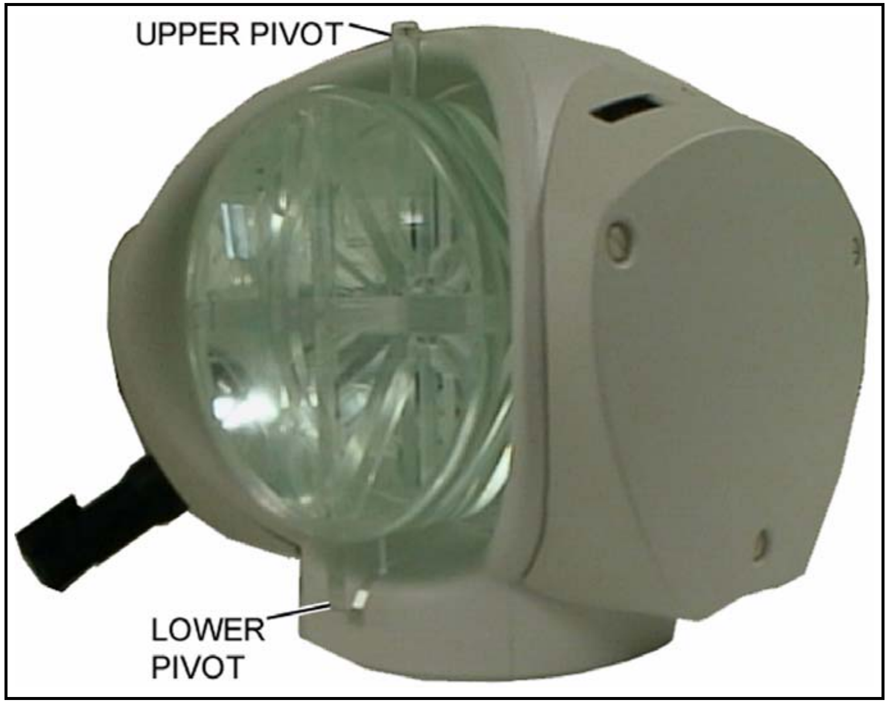
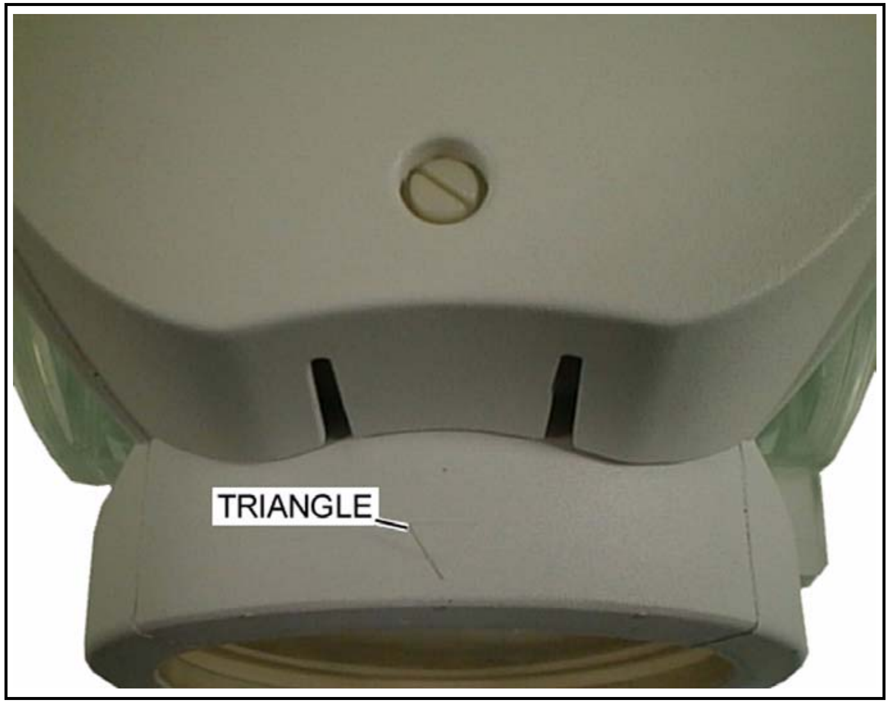
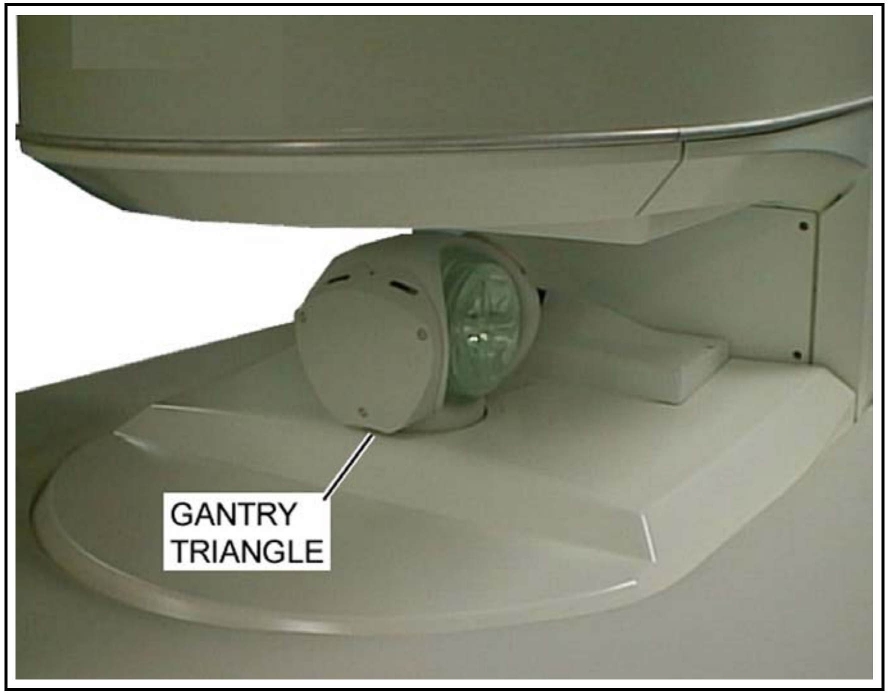


Fig. 165: Knee Coil 2



- Place the coil into the Gantry of the Magnet and connect it. The coil must be in the axial position: two triangles have been fitted (one on the coil base and one on the gantry). If the system doesn't have the triangle, refer to the following figures to place the phantom and the coil

Fig. 166: Phantom and Knee Coil placed into the Gantry in Axial



- In order to be certain that the phantom has been correctly positioned, the operator must perform a Scout sequence (select the district OTHER in the anatomy field) then check on the axial scout view if the vertical axis of the phantom is in vertical position

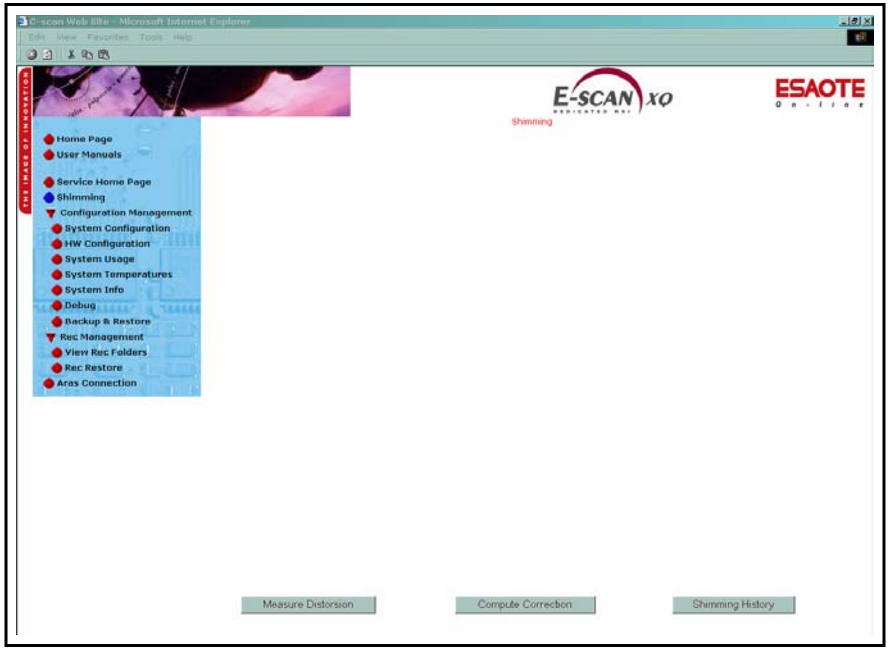
NOTICE	Perform the Transmission Coil Check before the Scout

- Now you can perform the shimming parameter acquisition

Shimming parameters acquisition

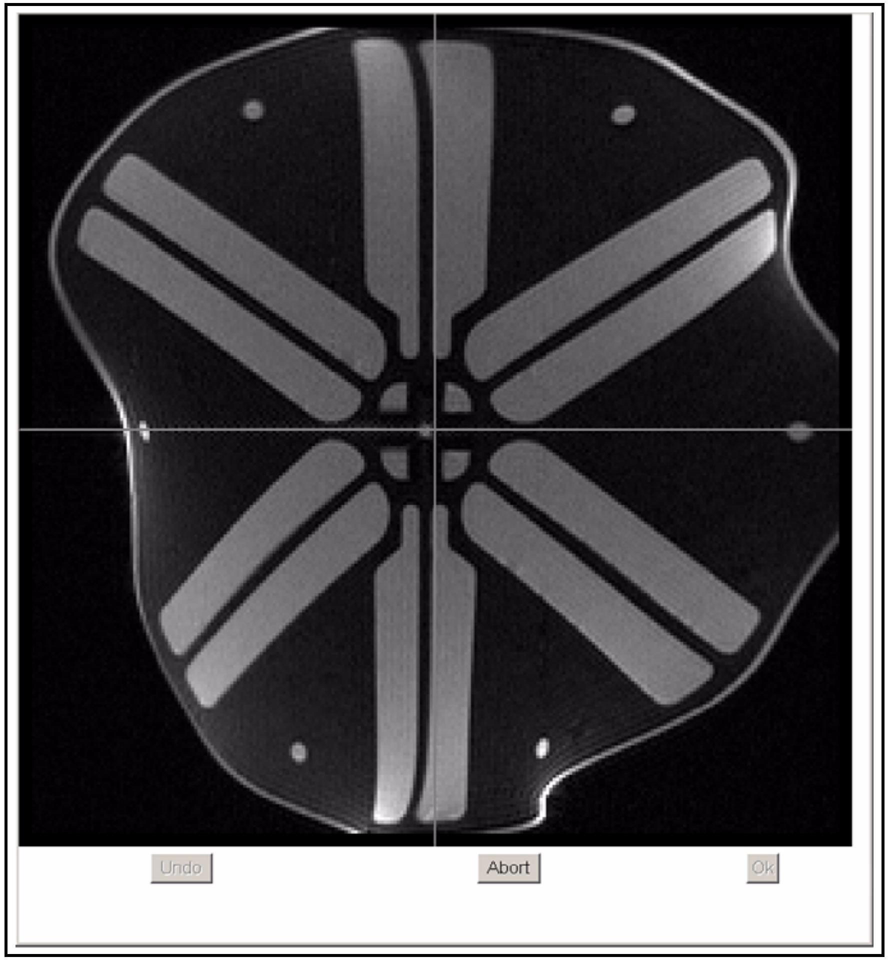
- Perform the shimming sequence acquisition selecting them from OPI inside **Protocol List, <Shimming>** folder (**Shimming Test Tra, Sag** and **Cor** sequences)
- When the three shimming phantom views have been obtained, the operator can access the shimming mask and perform the second order coefficients measurement
- Open Internet Explorer, **<Shimming>** Page

Fig. 167: Shimming page



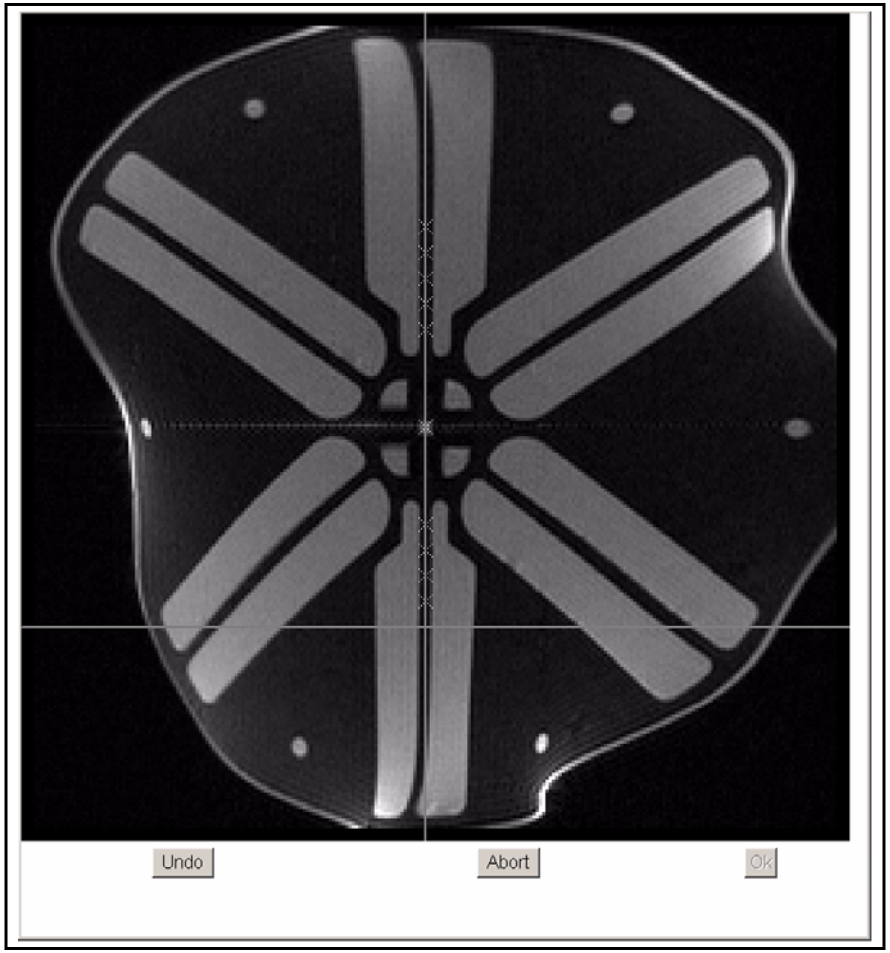
- Press the **Measure Distortion** button and the axial view will be automatically displayed

Fig. 168: Axial image



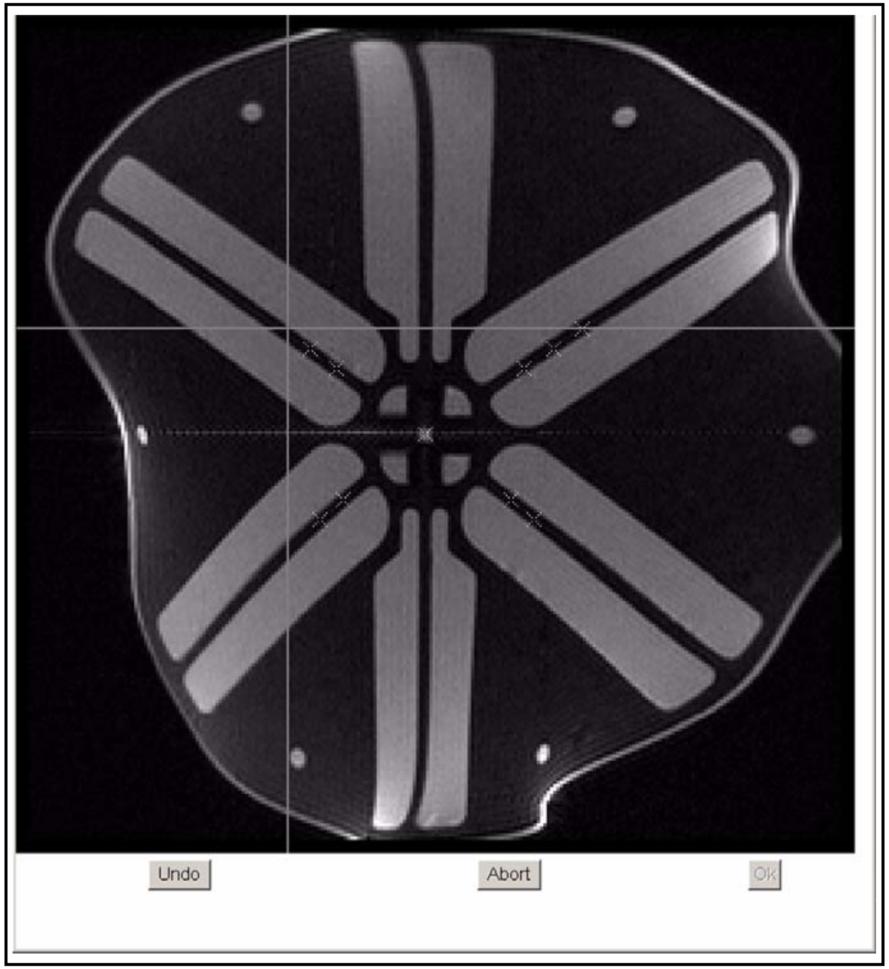
- Now, holding the mouse-right button, center the X prompt on the image center. When the X prompt is on the image center, release the mouse right button. Then, using the same method, align the X prompts along the image vertical axis (like shown in the next figure)

Fig. 169: X prompt centered on the image center



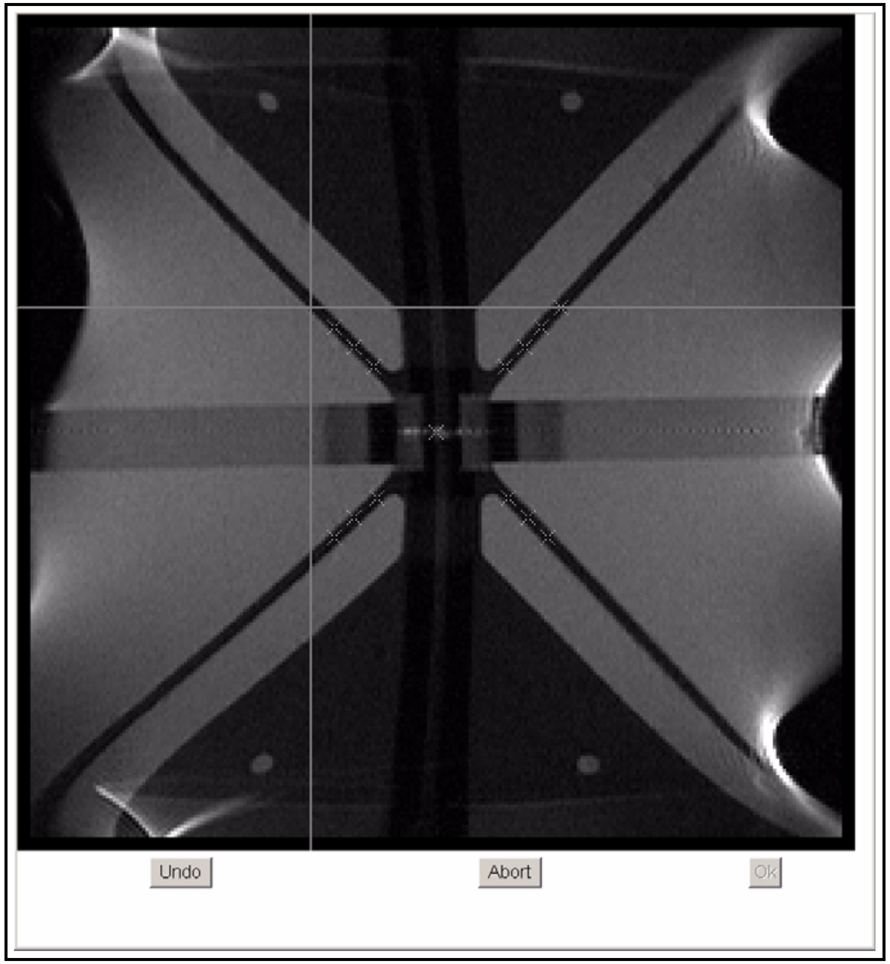
- When all the X prompts are correctly aligned click on the OK button and align the X prompts along the image diagonal axis otherwise click on the Undo button and repeat the alignment

Fig. 170: X prompts aligned on the image diagonal axis



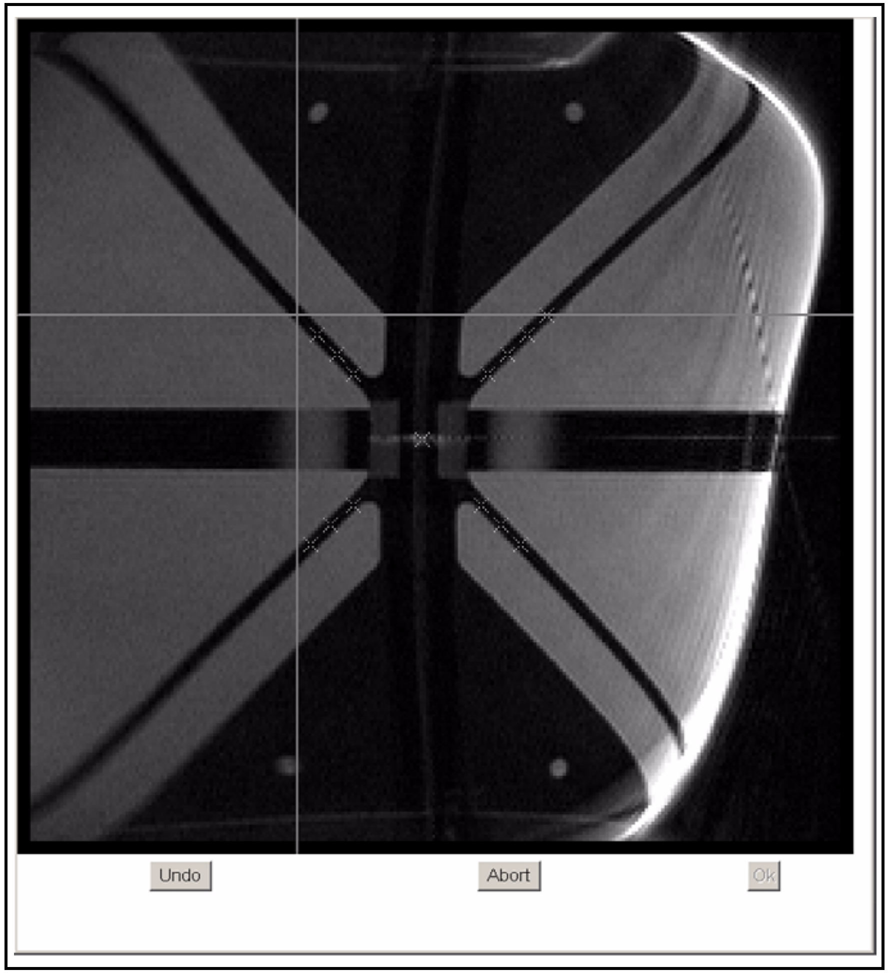
- When all the X prompts are correctly aligned click on the OK button and repeat the procedure centering and aligning the X prompt on the diagonal axis of the Sagittal image

Fig. 171: Sagittal image with center and X prompt aligned



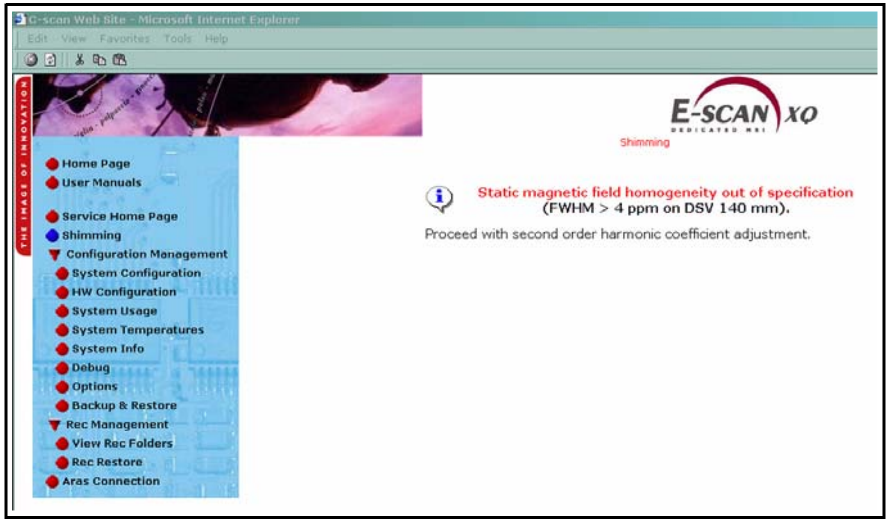
- When all the X prompts are correctly aligned click on the OK button and repeat the procedure centering and aligning the X prompt on the diagonal axis of the Coronal image, otherwise click on the Undo button and repeat the alignment

Fig. 172: Coronal image with center and X prompt aligned



- When all the X prompts are correctly aligned click on the OK button and the System will compute the shimming calculation telling you if it's necessary or not proceed with the parameters correction, otherwise click on the Undo button and repeat the alignment. If the parameters are correct the procedure is finished and you have to fill in the **Installation Quality Form** with the saved values

Fig. 173: Shimming Parameters out of specification Message



Static magnetic field homogeneity out of specification
(FWHM > 4 ppm on DSV 140 mm).

Proceed with second order harmonic coefficient adjustment.

- If the parameters are correct the procedure is finished
- If the parameters are not correct disable the SGRA module switching off the Electronic Unit, then open the magnet and remove the shimming plates as described in the Repair section

Repair

MTCM Board

- Shut down the system
- Open the Electronic Unit door
- Disconnect all the cables connected to the Signal Box
- Remove the Signal Box and open it
- Replace the MTCM board with the new one
- Close the Signal Box and place it inside the Electronic Box
- Connect all the cables back to the Signal Box
- Switch on the system
- From ARAS perform the Temp Check and see if the MTCM is providing power to the Magnet

TPM Module

- Shut down the system
- Open the Electronic Unit door
- Disconnect all the cables connected to the TPM Module (also the power plug connected to the Module rear side) and remove it
- Replace it with the new one and connect all the cables back
- Switch on the system
- From ARAS perform the Temp Check and see if the TPM is providing power to the Magnet

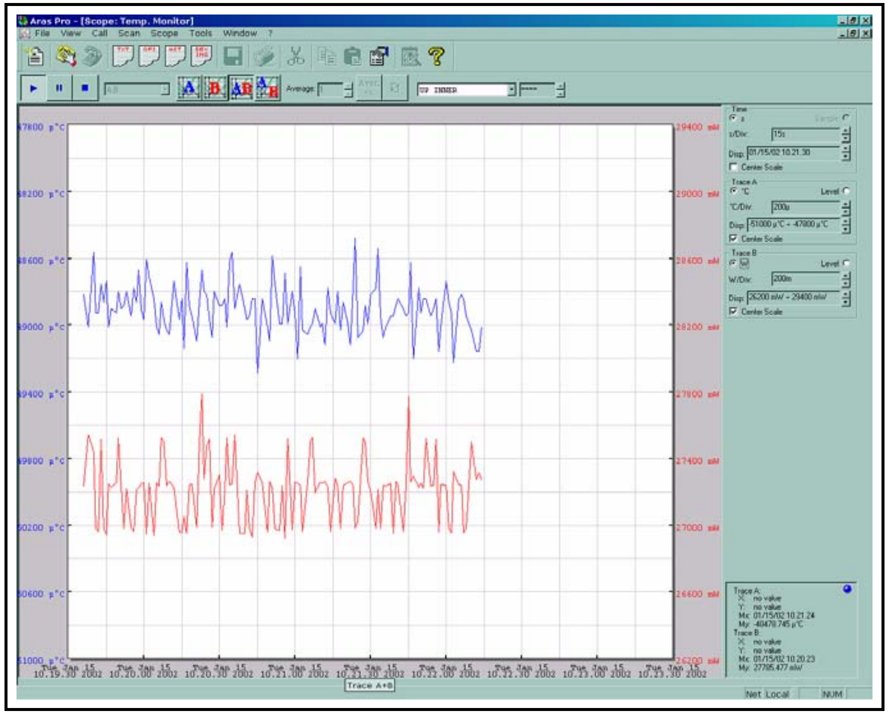
Final Check

Either if you have replaced the MTCM or the TPM, after some hours repeat the Thermal Stability test.

Thermal Stability

- Select, under ARAS, **<Test> <Troubleshoot.> <Temp. Monitor> <Exec**>
- The System diascope displays the power and the temperature of every magnet channel, as shown in figure
- Select one magnet channel clicking on Channel arrow buttons
- Select **<A>** and **<Y>** from the menu bar
- Center the temperature line changing the **<Displacement>** and zoom it using **<Dec. Div.>**
- Select **<B>** from the menu bar
- Center the power line changing the **<Displacement>** and zoom it using **<Dec. Div.>**
- Select **<Dual>** function in the Diascope bar to display power and temperature
- Let the System test run until the temperature and power lines are almost at the end of the visualization display then click on **<Pause>** function in the Diascope bar

Fig. 174: Temperature and Power traces



Time
● s
s/Div: 15s
Disp: 01/15/02 10.21.30
☐ Center Scale

Trace A
● °C Level ○
°C/Div: 200µ
Disp: -51000 µ°C ÷ -47800 µ°C
☑ Center Scale

Trace B
● W Level ○
W/Div: 200m
Disp: 26200 mW ÷ 29400 mW
☑ Center Scale

Trace A:
X: no value
Y: no value
Mx: 01/15/02 10.21.24
My: -40478.745 µ°C
Trace B:
X: no value
Y: no value
Mx: 01/15/02 10.20.23
My: 27785.477 mW

- Using the cursor, measure the maximum and minimum values of the temperature line

  Temp Mean = (Temp MAX + Temp MIN) / 2

  Temp Deviation = Temp MAX - Temp MIN
- Fill the Quality Form with the calculated values
- Using the cursor, measure the maximum and minimum values of the power line

  Power Mean = (Power MAX + Power MIN) / 2

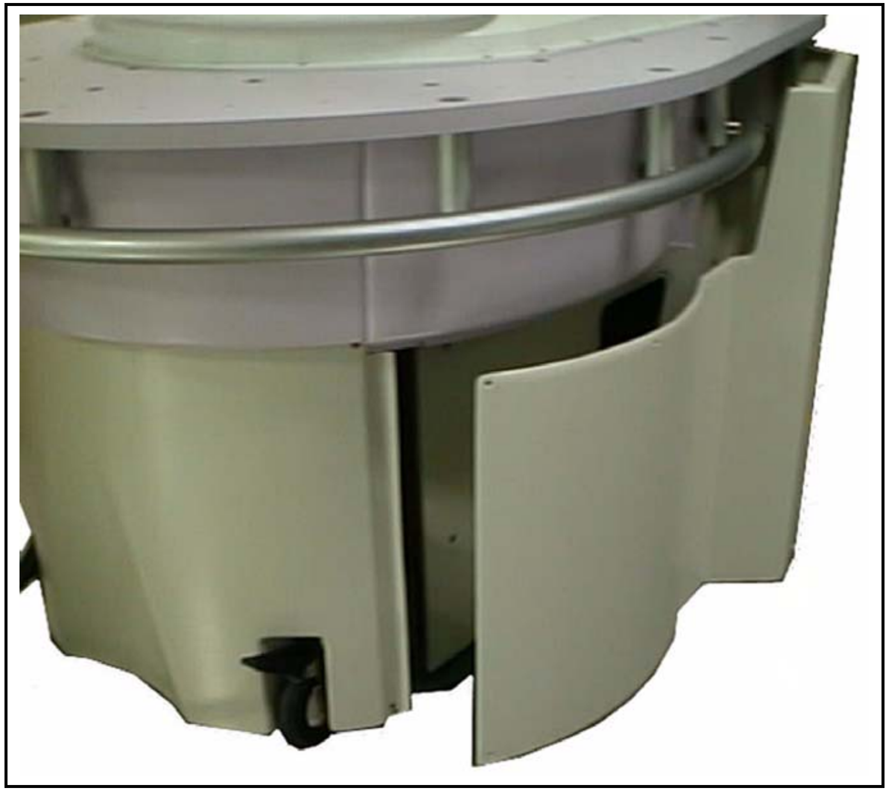
  Power Deviation = Power MAX - Power MIN
- Fill the Quality Form with the calculated values
- Select the next channel and repeat the centering and measuring procedure for every magnet channel
- At the end, click on **<Quit>** to escape from the test

Shimming

Access to the shimming plates

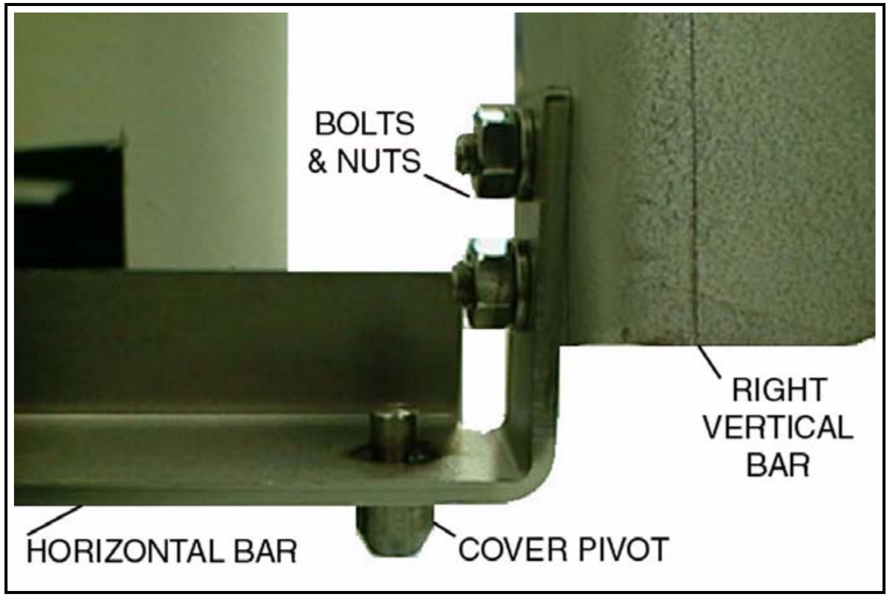
- Remove the two lower side covers of the patient bed. Screws are fitted along the covers to fix them to the other covers and on the top to fix them to the round table on the patient bed

Fig. 175: Lower lateral cover



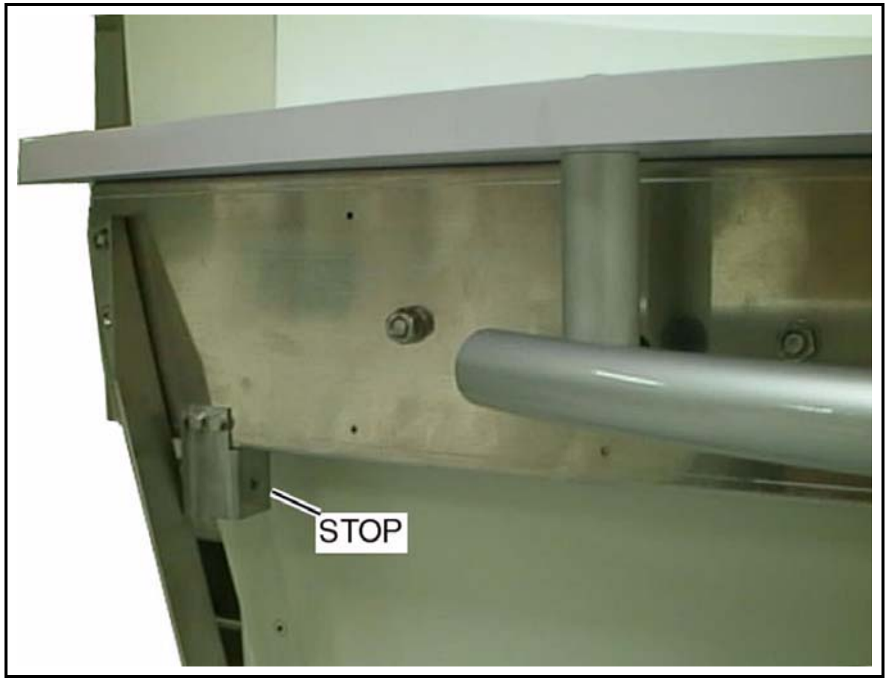
- Now remove the horizontal bar shown in the following figure. To remove it unscrew the bolts on each side used to fix the horizontal bar to the vertical bars

Fig. 176: Horizontal bar



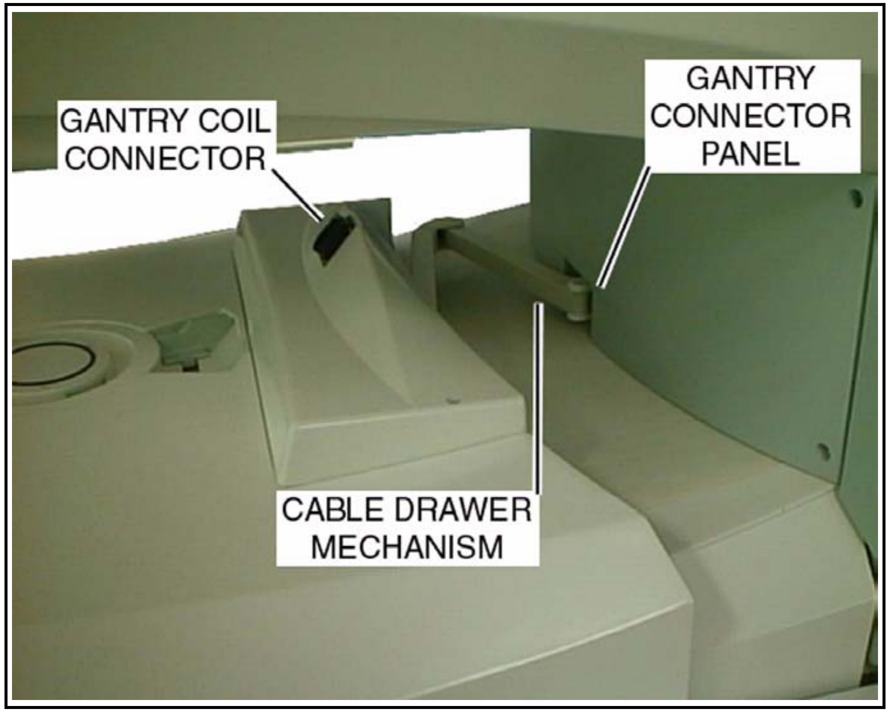
- To take the patient bed out completely you must first remove the two patient bed stops (one per side) placed on the magnet brackets and fixed using two bolts, as shown in the following figure. In order to gain better access to them you can also remove the top covers

Fig. 177: Magnet brackets stop



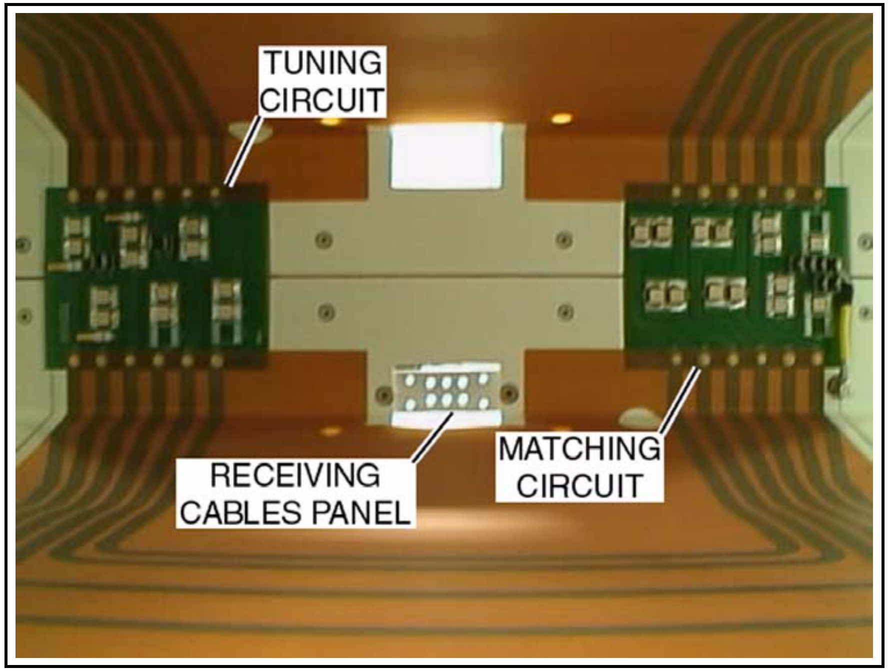
- Disconnect the receiving cable drawer and slide the patient table out completely.

Fig. 178: Receiving cable drawer



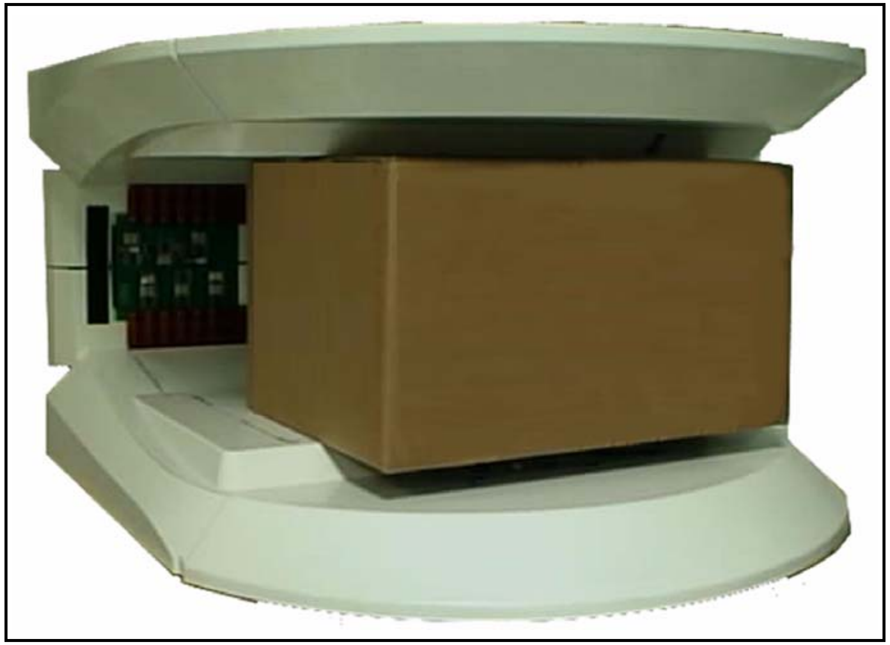
- Remove the receiving cables panel

Fig. 179: Transmitting circuits and coil



- Remove the transmitting circuits (matching and tuning shown in the previous figure)
- Remove the top screws (four metallic and four plastic) from the top gantry cover
- Before starting to dissemble the gantry insert something in the magnet to prevent the gantry from breaking. As written before two covers comprise the gantry and they are joined by the aluminum plates

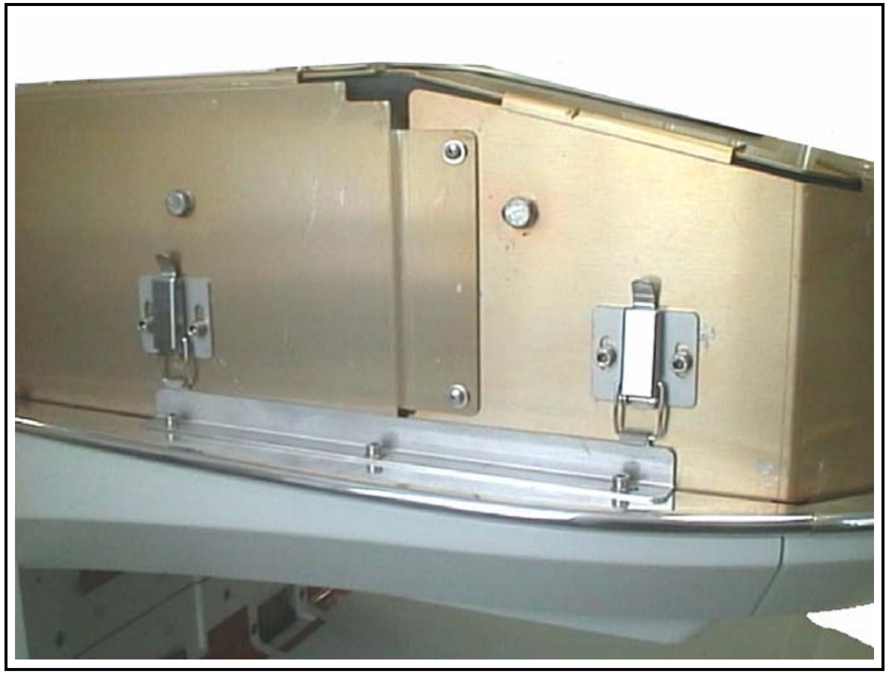
Fig. 180: Insert a box into the magnet to avoid gantry breaking



- The gantry is fixed to the magnet structure by screws along the upper and lower metallic profiles and in same cases with clips as shown in the following two figures

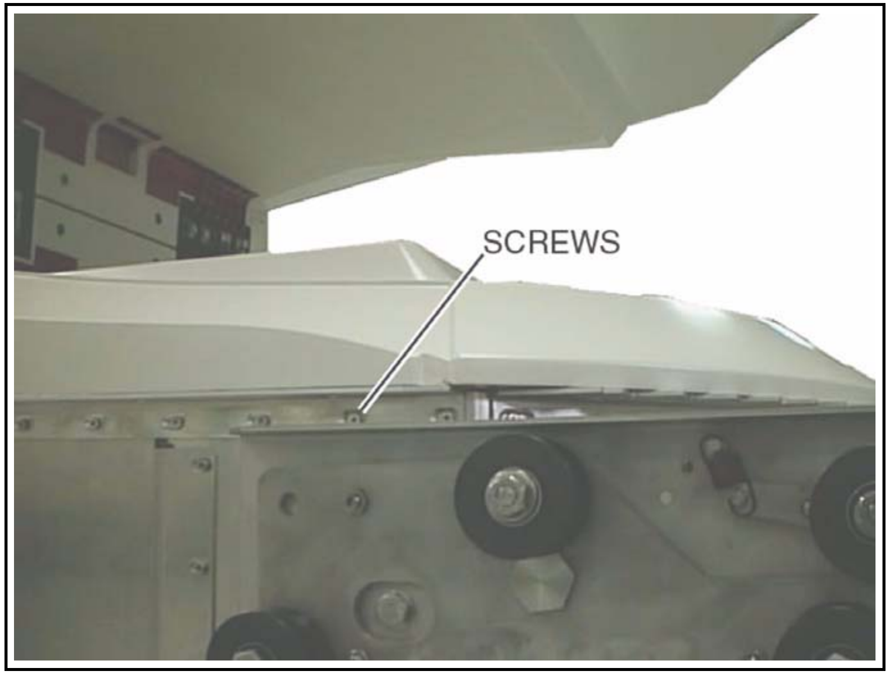
NOTICE	The new Magnets have clips instead of screws to fix the Gantry and only four screws on the front side

Fig. 181: Upper metallic profile with clips



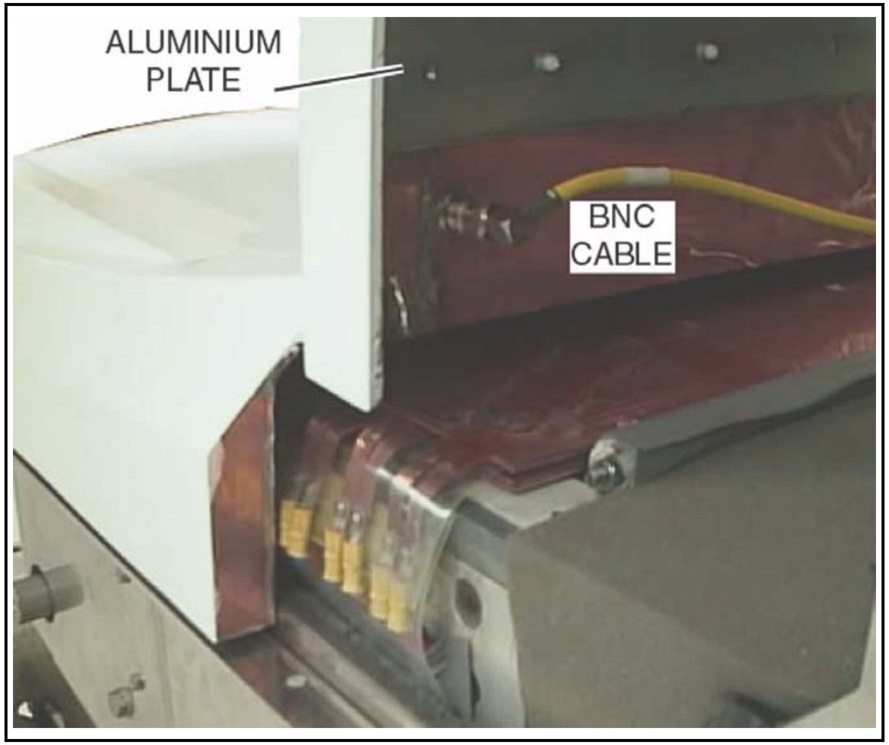
- Using a Philips screwdriver, remove the screws that fix the metallic upper profile to the magnet to remove the upper gantry cover

Fig. 182: Lower metallic profile



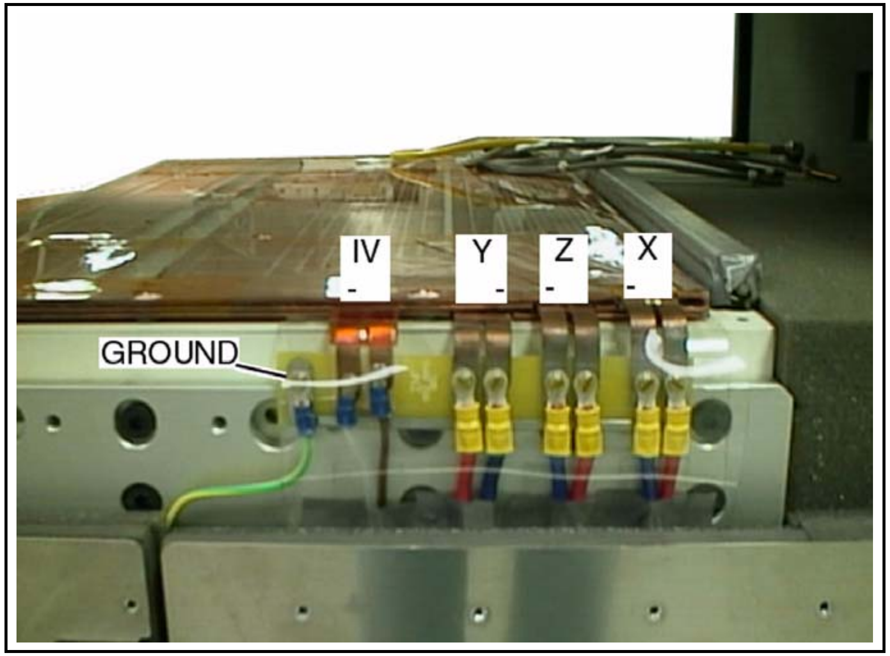
- In the lower side using a Philips screwdriver, remove the screws that fix the metallic lower profile to the magnet structure and leave the lower metallic profile fixed to the gantry
- Before removing the lower gantry cover disconnect the BNC cable connected on the back of the gantry as shown in the next figure

Fig. 183: Gantry BNC cable and aluminum plate (rear view)



- Now you can disconnect the gradient upper and lower cables and

Fig. 184: Lower gradient coil connections



- Remove the gradient coils by unscrewing the plastic screw s

---

⚠**WARNING** **The SGRA must be disabled when disconnecting the gradient cables. To do that switch off the Electronic Unit.**

Fig. 185: Lower gradient coil

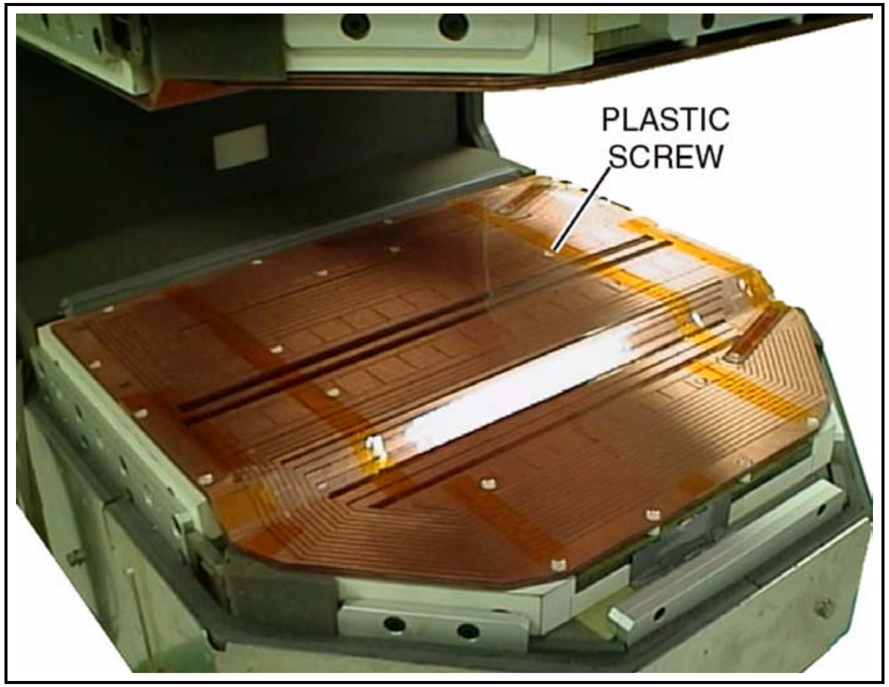
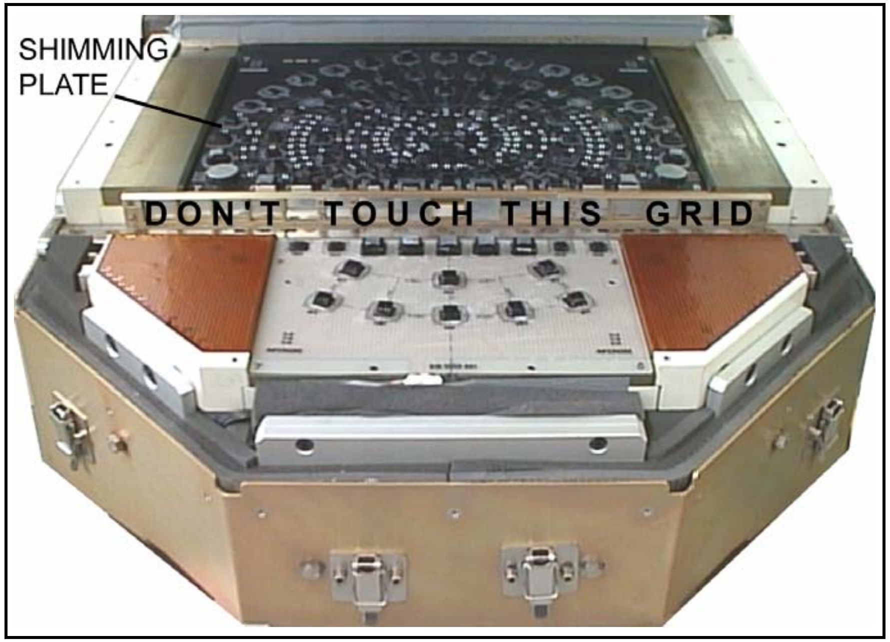


Fig. 186: Lower shimming plate



- After the gradient coils (upper and lower) are removed the plastic shimming plates are visible. Remove them (upper and lower) and go ahead with this procedure

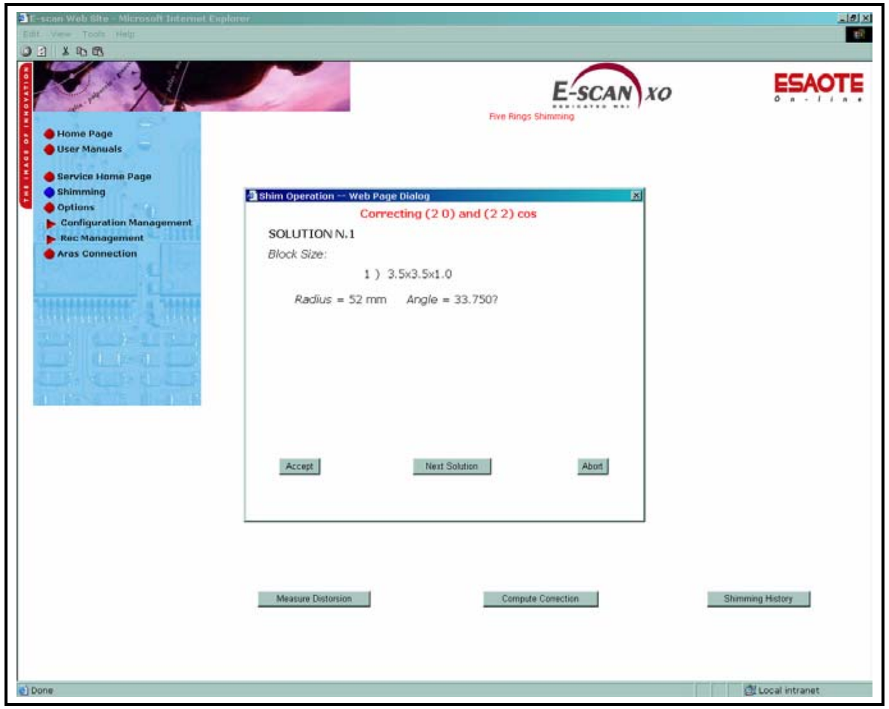
---

⚠**WARNING** **Don't remove any other hardware after removing the Gradient Coils. If you do it you cause the permanent shims to come loose from their position and ruin the magnet shimming and image quality permanently!**

Shimming parameters correction

- From Explorer, Shimming page, press the **Compute** button and the system will give you the easiest of many possible solutions
- Check if the suggested position on the shimming plate is empty or not: if it's empty select **<YES>**; otherwise select **<NO>**

Fig. 187: Suggested solution



Correcting (2 0) and (2 2) cos

SOLUTION N.1

Block Size:

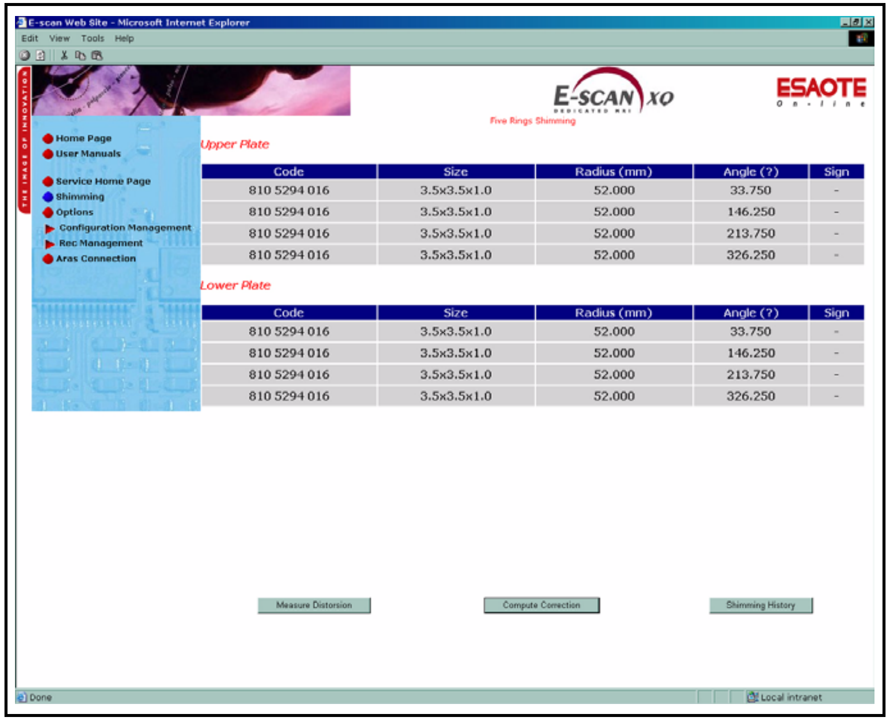
1) 3.5x3.5x1.0

Radius = 52 mm   Angle = 33.750?

NOTICE	You only need to check one position because the neodymium pieces are glued on symmetrical positions

- If you type **<YES>** the system will show you or the solution to correct another wrong parameter or all the positions that compound the accepted solution

Fig. 188: Use the scroll bar to display also the Lower plate



Upper Plate

Code	Size	Radius (mm)	Angle (?)	Sign
810 5294 016	3.5x3.5x1.0	52.000	33.750	-
810 5294 016	3.5x3.5x1.0	52.000	146.250	-
810 5294 016	3.5x3.5x1.0	52.000	213.750	-
810 5294 016	3.5x3.5x1.0	52.000	326.250	-

Lower Plate

Code	Size	Radius (mm)	Angle (?)	Sign
810 5294 016	3.5x3.5x1.0	52.000	33.750	-
810 5294 016	3.5x3.5x1.0	52.000	146.250	-
810 5294 016	3.5x3.5x1.0	52.000	213.750	-
810 5294 016	3.5x3.5x1.0	52.000	326.250	-

Fig. 189: Shimming Plate

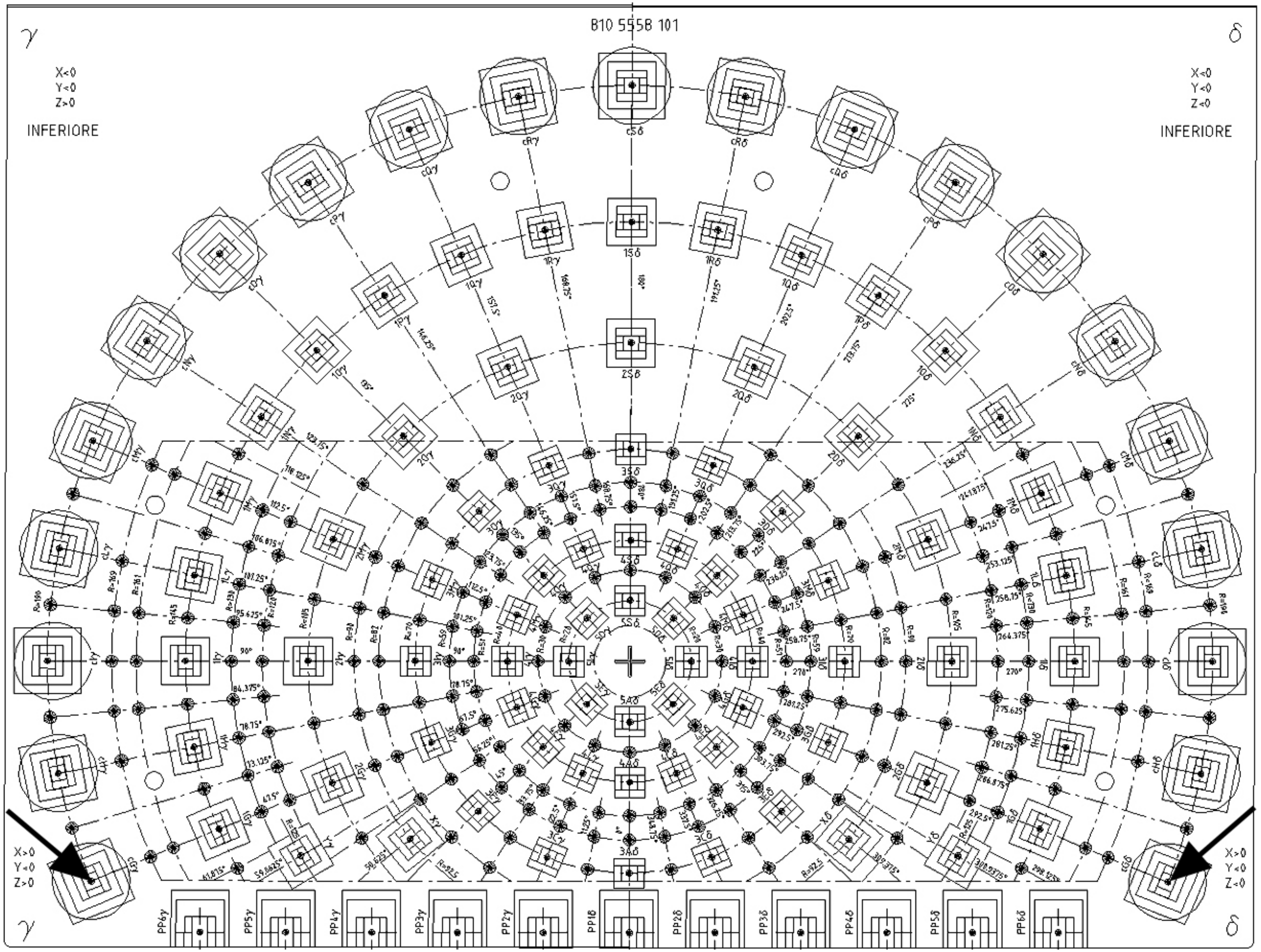
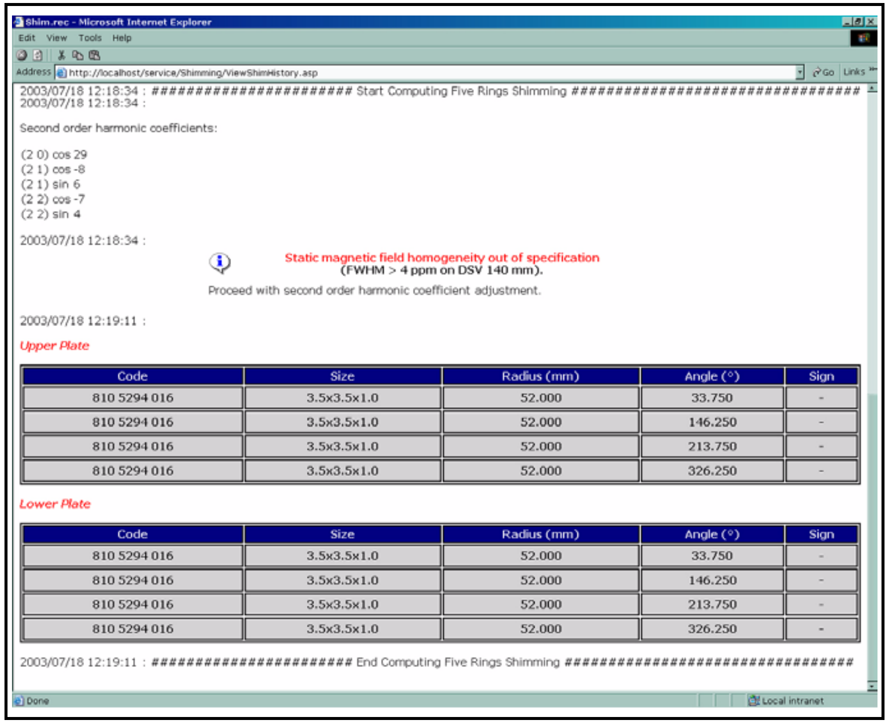


Fig. 190: Shimming History Table


Shim.rec - Microsoft Internet Explorer
Edit View Tools Help
Address http://localhost/service/Shimming/ViewShimHistory.asp
Go
Links
Done
Local intranet

```
2003/07/18 12:18:34 : ####################### Start Computing Five Rings Shimming ##################################
2003/07/18 12:18:34 :

Second order harmonic coefficients:

(2 0) cos 29
(2 1) cos -8
(2 1) sin 6
(2 2) cos -7
(2 2) sin 4

2003/07/18 12:18:34 :
```

Static magnetic field homogeneity out of specification
(FWHM > 4 ppm on DSV 140 mm).

Proceed with second order harmonic coefficient adjustment.

2003/07/18 12:19:11 :

Upper Plate

Code	Size	Radius (mm)	Angle (°)	Sign
810 5294 016	3.5x3.5x1.0	52.000	33.750	-
810 5294 016	3.5x3.5x1.0	52.000	146.250	-
810 5294 016	3.5x3.5x1.0	52.000	213.750	-
810 5294 016	3.5x3.5x1.0	52.000	326.250	-

Lower Plate

Code	Size	Radius (mm)	Angle (°)	Sign
810 5294 016	3.5x3.5x1.0	52.000	33.750	-
810 5294 016	3.5x3.5x1.0	52.000	146.250	-
810 5294 016	3.5x3.5x1.0	52.000	213.750	-
810 5294 016	3.5x3.5x1.0	52.000	326.250	-

```
2003/07/18 12:19:11 : ####################### End Computing Five Rings Shimming ##################################
```

NOTICE	In case of two or more out of spec shimming parameters, the software suggests different solutions for each parameter: if two or more solutions use the same positions don't worry: the final solution will take care of it

- Take notes of the positions and select **<Quit>**. If you need to read the solution again press the **Shim History** button of the Shimming page
- Now place the neodymium pieces on the shimming plates making sure their positions, dimensions and polarity comply with the software indications. Regarding polarity, use the two pieces indicated by arrows in the previous figure of the shimming plate as a reference: their polarity is always positive in every magnet. Use double-sided tape and paper tape to fix the pieces, do not use glue for the moment

NOTICE	Positive for the upper shimming plate means negative for the lower shimming plate and vice versa

- Re-place the shimming plates into the magnet and re-place all the parts that make up the magnet (gantry and patient bed) and re-connect all the cables following the procedures before explained and enable the SGRA module re-connecting the Power cable (rear side)
- Repeat the shimming parameters procedure from the beginning
  - If the parameters are now correct fix the neodymium pieces with glue using this procedure to have access to the shimming plates
  - If the parameters are not correct remove the shimming plates and check the polarity and position of the shimming material placed on the plates to correct the wrong parameters. If everything is correct proceed with another shimming parameter correction using this procedure

NOTICE	When making shimming adjustments repeat the System calibration from the Homogeneity Test

Test and adjustment table

MODULE	TEST	ADJUSTMENT
MTCM and/or TPM	Check if the new module is working perform the automatic test, under ARAS, select <**Test**> <**Trouble Shoot.**> <**Temp. Check**>. Or monitoring powers and the temperatures selecting, under ARAS, <**Test**> <**Trouble Shoot.**> <**System Monitor**>	Perform the Stability Test and fill in the Quality Form
MAGNET SHIMMING	Perform the **Gradient orientation check** to be sure about the correct Gradient Cables connection	Calibrate the system and fill in the Quality Form

Part 11 Power Distribution

Introduction

In this section you will find the strategies for trouble shooting on the power distribution.

Strategy

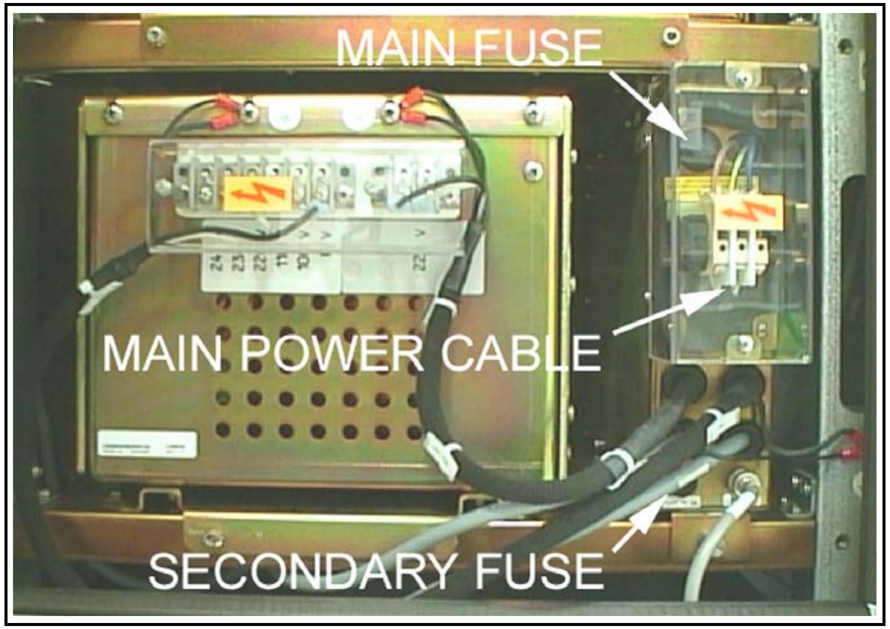
This chapter describes the test strategy for the Power Distribution

CAUTION	**Voltage continues to be present at the line voltage transformer even after the MR system has been switched off. The line power Distributor must be switched off for service work and the on-site circuit breakers must be set to OFF**

The green Power Light is located on the left side of Electronic Unit Switch. If it goes off there is a problem in the main line or the light bulb.

- Check if the feeder circuit breaker is switched off
- Check if the main system fuse is interrupted
- Check if the secondary system fuse is interrupted

Fig. 191: System fuses and main power cable position



- Check if the insulation transformer input and output are correctly set

Repair

Checking the line voltage

- Lock all emergency shutdown buttons
  - Prior to switch-on, several adaptations to the line voltage must be made
- Ask your project manager about the on-site line voltage and perform your own measurement

The on-site line voltage is: **V AC**

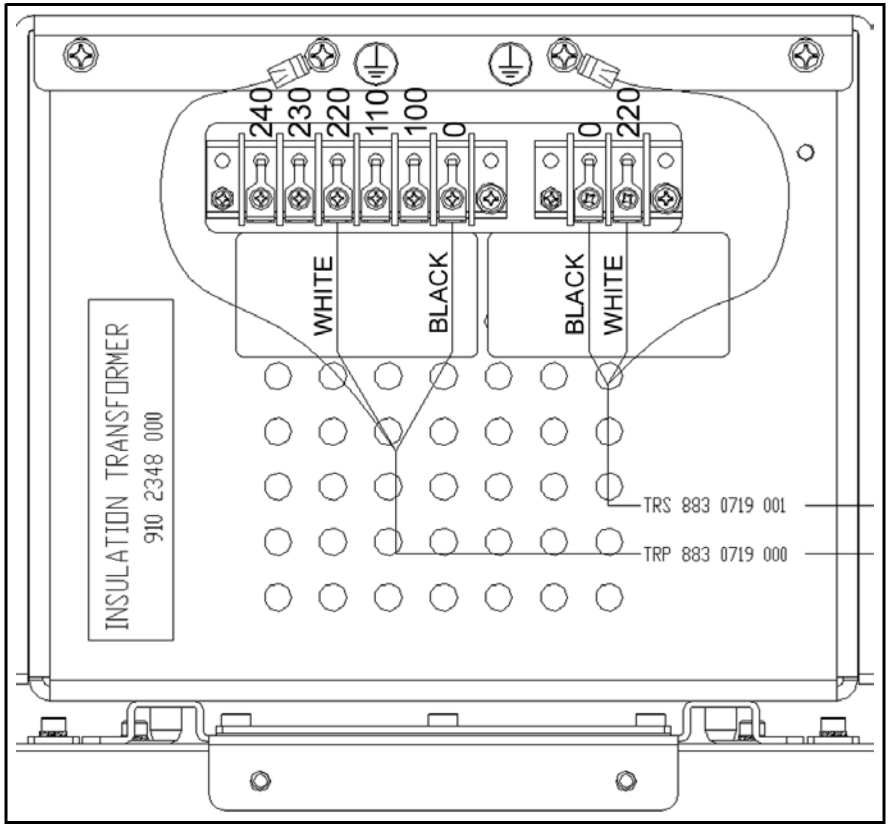
NOTICE	Shut down the on-site power supply and secure it with a lock to prevent anyone from inadvertently switching it on

Adapting transformer to the line voltage

Check if the primary stage of the insulation transformer is correctly set for the main supply voltage of the country where the system is installed. Refer to the figure for transformer settings.

The insulation transformer is inside the console above the SGRA module at the right side of the main fuse.

Fig. 192: Possible transformer input voltages



NOTICE The secondary voltage from the console transformer is 220 V

Check if the main fuse has the correct value (depending on the country main power supply) and check if it's interrupted:

- Fuse 15 A for 100 ÷ 110 V AC supply voltage, Ch T
- Fuse 6.3 A for 220 ÷ 240 V AC supply voltage, Ch T

The secondary fuse already inserted in the secondary stage of the transformer is:

- Fuse 6.3 A for 220 out put voltage, Ch T

There are other kinds of fuses used in the System. Some of them are accessible removing the small cover on the main power plug.

These fuses can be found in the spare part installation kit and their values are:

Tab. 32: Fuses values and position

Module	**Fuse value**			**Ch**
SGRA	6.3 A	10 A	1.6 A	T
SRFA	3.15 A	0.25 A		T
TPM	6.3 A	3.15 A		T

The mains must be equipped with a RCCB (Residual Current Circuit Breaker) even not dedicated. The RCCB is also called ELCB (Earth Leakage Circuit Breaker) or RCD (Residual Circuit Device) or GFI (Ground Fault Interrupter). This device is for breaking a circuit automatically when it senses fraction of an Ampere leakage current flowing to earth in excess to predetermined amount.

The system must be connected directly or through an UPS system to a 16A CB (Circuit Breaker) that is connected to the previously described RCCB. The CB is a re-settable switch that is tripped either by long term over current operated by a thermal mechanism or by short term over current by a magnetic mechanism.

These breakers must have been approved according to the international and/or national and/or federal and/or local regulations in force and they must be installed in a wall-mounted sheltered box near the unit. Wiring between the system and the CB must be via the three-wire cable supplied with the system itself. It must be cut to the appropriate length and cable end sleeves must be inserted before inserting them into the terminal connection.

The equipment must be permanent connected to the Mains (according to EN 60601-1); therefore the cable can be removed only by means of a special tool (e.g. a screwdriver).

Grounding is required. An electric wire with a minimum nominal cross-section of 1.5 mm^2 must ground the equipment (according to EN 60601-1).

The two cables provided with the equipment are the following:

- **Code 810 5901 000** it is the UL/CSA one and must be used in USA and Canada:
  - 10 m long
  - The yellow-green wire is the grounding wire: it must be connected to the ground terminal of the main line
  - The two black numbered cables (phase and neutral) must be connected to the phase and neutral terminals of the CB
  - Nominal cross-section of each of its wires is 15 AWG (about 1,65 mm^2)
- **Code 810 5901 001** it is the IMQ one and must be used in Europe:
  - 10 m long
  - The yellow-green wire is the grounding wire: it must be connected to the ground terminal of the main line
  - The brown wire is the phase wire: it must be connected to the phase terminal of the CB

- The blue wire is the neutral wire: it must be connected to the neutral terminal of the CB
- Nominal cross-section of each of its wires is 1.5 mm^2

⚠**WARNING** **Be sure to correctly identify the phase and neutral wires when connecting the equipment or when wiring the separating switch!!!**

If additional optional lights are installed in the pavilion, you must install a dedicated separating switch and insert the power cables into a dedicated duct to avoid electric shocks.

The dedicated plug for the optional lights is located on the filter panel and has the following characteristics: 250 V MAX and 5 A MAX. No dimmer or fluorescent lights may be used.

⚠**WARNING** **All the main power cables and the cables from the console to the filter panel and from the filter panel to the magnet must be inserted under the floor or into the delivered duct that must be fixed to the floor**

Part 12 Maintenance Instructions

Maintenance Protocol

The system maintenance does not require any critical or difficult operations, but some periodic controls are summarized in the following table.

Make a paper copy of the following Maintenance table and fill it during the periodic system maintenance.

NOTICE	This suggested maintenance plane is the minimum acceptable maintenance plan

NOTICE	At the end of maintenance procedure, make a copy of the table that has been filled in and file it in the Logbook

NOTICE	Don't use alcohol to clean the system components: use only neutral soap.

Tab. 33: Maintenance instructions period six months and year

Performed by	☐	**System Ser/N**	☐	**Customer**	☐	**Date**	☐

DESCRIPTION	TOOLS & FORMS	PROCEDURE	FREQUENCY	DONE	N/A	OK	NOK
System calibration control	Quality form	See the Installation Guide, Tune Up chapter	every six months	☐	☐	☐	☐
TX signal control for transmission coil		See the Installation Guide, Tune Up chapter	every six months	☐	☐	☐	☐
Power cord check		Visual inspection of the integrity of the external sheath	every six months	☐	☐	☐	☐
Power light check		Visual inspection of the green light, and of the switch placed in the left cover of the Electronic box	every six months	☐	☐	☐	☐
Cleaning the gantry	brush (or compressed air spray)	Extract the coil possibly present in the gantry and clean the TX coil using the brush to remove any dust	every six months	☐	☐	☐	☐
Cleaning of the RX coils and functionality test of insertion in the gantry	soft cloth, water, neutral detergent	Extract the RX coils and remove any dust using the soft cloth and the neutral detergent. Allow the detergent residuals to evaporate, then mount the coil in place and check functionality.	every six months	☐	☐	☐	☐

DESCRIPTION	TOOLS & FORMS	PROCEDURE	FREQUENCY	DONE	N/A	OK	NOK
PC Unit and Electronic Unit internal dust cleaning	Screwdrivers Philips tip medium size, standard tip, Allen key 4 mm, brush	Following the standard procedure shut down the system. Take the power cord off the PC Unit, open the case and using the brush or compressed air remove any dust from the boards (removing them from their places if needed). At the end of the cleaning procedure connect everything again and check for proper functioning. Repeat the same procedure for the Electronic Unit.	every six months	☐	☐	☐	☐
Cleaning and functional check of the cooling fan (with the exception of the MTCM board and TPM module)	Screwdriver standard tip, Allen key n. 4, brush (or compressed air spray)	Following the standard procedure shut down the system. Open the electronic unit box patient side to get access to the fan and remove any dust. Be careful of the two smaller fans which are still in function. At the end restart the system and check fan functionality, then close the metallic cover and check for functionality of the cover fan. Close the plastic cover.	every six months	☐	☐	☐	☐
Patient bed functional control		Check the wheel and brake functionality, if necessary lubricate the wheel bearings	every six months	☐	☐	☐	☐
Modular shielding box		Check the doors and the fingers	every six months	☐	☐	☐	☐
Check the integrity and number of cushions		For the number of cushions required, refer to the relevant chapter in the User Manual	every six months	☐	☐	☐	☐
RX coils tuning check	Quality Form	Check varicap and 180° pulse for every coils	every six months	☐	☐	☐	☐

DESCRIPTION	TOOLS & FORMS	PROCEDURE	FREQUENCY	DONE	N/A	OK	NOK
Check: ground screws, cables, connector caps both of the PC Unit, Magnet and of the Electronic Unit	Screwdrivers Philips tips, standard tips, Allen keys or adjustable spanners	Remove the Electronic Unit and Magnet Unit covers to gain access to the cables and connectors: after checking and screwing all the covers until they are closed	every six months	☐	☐	☐	☐
Check the safety labels		Inspect the labels on the Magnet and on the Site door to make sure they are legible	every six months	☐	☐	☐	☐
System Back-up		Refer to the Software chapter of this Manual	every six months	☐	☐	☐	☐
Check the Pavilion copper fingers	Fingers	Check the condition and eventually replace the Pavilion Doors and Electronic Box Door Finger	every six months	☐	☐	☐	☐
Shimming parameters check	Shimming kit	Check and eventually correct the Magnet shimming parameters	every year	☐	☐	☐	☐
Protective Conductor Measurements		Check the System insulation	every year	☐	☐	☐	☐

Note

Electrical Safety Tests

NOTICE The entire grounding cabling must be installed, before this test can be performed.

Refer to the Installation Guide, Start-Up chapter for all the explanations.

Tab. 34: Fuses values and position

Measurement device	Type	Ser/N	Date	Performed by

Pavilion Maintenance

The parts of the Pavilion subject to periodical maintenance are:

- Fingers and contact surfaces
- Upper and lower sliding device of the two shutters

NOTICE	In case of replacement perform the Pavilion Shielding Check (refer to the Installation Guide)

Fingers and contact surfaces

In order to maintain the Pavilion's performance during operation, contact surfaces and fingers must be periodically polished, that is to say, cleaned and greased. Clean the above-mentioned elements with an alcohol or proper electric contact cleaner.

The fingers called A16 and A17 in the Pavilion Installation paragraph are contained in the Set Of Fingers (ITEL code 7106813).

Fingers of the shutter closing set

To replace these fingers:

- Dismantle the U profile on the shutter closing set (DC code)
- Remove the finger strip to be replaced and insert the new strip (A16 code)
- Re-install the U profile on the DL shutter

Side finger

To replace the side fingers:

- De-install the joints according to Doors structure installation paragraph
- De-install the finger supporting element (DFL and/or DFR code)
- Remove the finger strip to be replaced and insert the new strip
- Re-install according to Doors structure installation paragraph

Upper and lower fingers

For type 2 fingers, fixed on the upper and lower part of the door, you must:

- dismantle the shutter by loosening the fixing bolts on the upper sliding system
- remove the finger strip to be replaced
- clean the contact surface with alcohol or solvent, remove the protecting film from the new finger strip and stick it
- reinstall the shutter and adjust it

Door sliding device

The top and bottom sliding devices of the door must be greased periodically to ensure that they move easily and comfortably and they must be adjusted following the instruction in the paragraph dealing with the installation of the top mechanism.

These ordinary maintenance operations must be carried out every six-months or when the door becomes difficult to handle.

The Door Closing Set is available use this ITEL code to order it: 7106821.

Painting

A painting kit is provided with the Pavilion. Use it to perform maintenance on the Pavilion in accordance with its color.

If necessary use the potassium nitrate solvent.

NOTICE	Check that the Pavilion attenuation is correct after working on the Pavilion fingers

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